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# AMERICAN ENGINEER TESTS.

## Locomotive Draft Appliances.

VII.

Report by Professor Goss.

(Continued from Page 67.)

### SECTION II.

### Equipment for Burning Oil.

8. Storage Tank.—By the courtesy of the Indianapolis office of the Standard Oil Company a 90-barrel tank was loaned the University, into which the contents of a tank car could be unloaded. This tank was located at a convenient point outside of the laboratory, at a level which permitted oil from cars to be unloaded by gravity. Oil as needed by the burners was drawn from this tank by means of a pump, in a manner to be hereafter explained.

9. Delivery of Oil to Burners.—To secure satisfactory action in an oil burner it is necessary that oil be supplied at a pressure which can be maintained constant, the degree of pressure being at all times under the control of the fireman. In stationary work, burners have often been fed from an elevated tank, which is kept filled to an overflow by means of a suitable pump. In locomotive service the same result has been attained by having the oil carried in a closed tank, to which air is admitted under sufficient pressure to carry the oil to the burners. In the experiments under discussion neither of these plans were followed, but as a substitute for them there was employed an automatic feeding device, handled by the National Supply Company, of Chicago, whereby oil is supplied with great regularity at any desired pressure. The apparatus was deposited with the University through the courtesy of its builders, the Snow Steam Pump Company, of Buffalo. It is known as a No. 3 double fuel-oil system, and is illustrated by Fig. 5. It is applicable either to locomotive or to stationary service. Throughout the experiments it never failed to supply the burners with oil at the pressure for which it was set, said pressure being entirely under the control of the engineer. A detailed description of this apparatus by Mr. E. E. Reynolds, who, as instructor in charge, has been immediately concerned with its operation, is as follows:

10. The Fuel-oil Pressure System, as manufactured by the Snow Steam Pump Works, Buffalo, and as installed for feeding fuel oil to the burner of the locomotive, consists of the following essential parts:

(a) A pair of duplex steam pumps for drawing the oil from the tank and maintaining the desired pressure in the receiver from which the burners are supplied.

(b) A cylindrical receiver containing a filtering compartment and a heating coil, and fitted with air chamber, thermometer and pressure gauge.

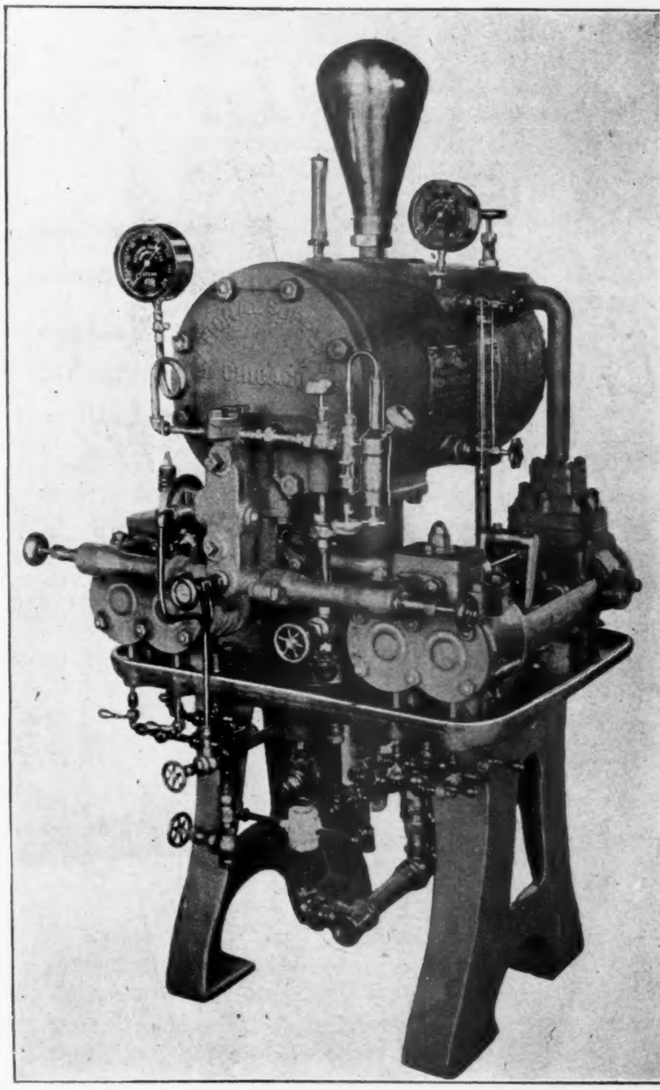

Fig. 5.

(c) A regulator or governor, actuated by the pressure in the receiver, and which automatically operates the pump so as to maintain the receiver pressure constant.

(d) An adjustable relief valve placed between the suction and the delivery sides of the pump, through which all oil in excess of requirements may pass, in case of accident, to the governor.

(e) A cast-iron base or frame, upon which the mechanism is securely mounted.

(f) The necessary piping, valves, etc., for steam, oil, water and drainage connections.

A view of the apparatus is shown by Fig. 5, and the detail drawings by Fig. 6. Only one of the pumps is operated at a time, the other being held in reserve in case of accident. The exhaust steam from the pump is conducted through the heat-

ing coil in the receiver and serves to warm the oil. Should the oil be thus heated to too high a temperature the heating coil can be cut out by means of a three-way plug and the exhaust thrown directly into the drain pipe. In case the oil is very cold, provision is made for sending live steam through the heating coil in such amounts as may be required.

The cylindrical receiver is kept about one-third full of water, the oil being pumped in on top of the water. Any water that may be pumped in with the oil is, therefore, separated by gravity in the receiver. The water-level is shown by a gauge glass on the side of the receiver, and any surplus accumulation of water may be drawn off at the bottom through the blow-off valve. The oil delivery pipe draws its supply from the top of the receiver.

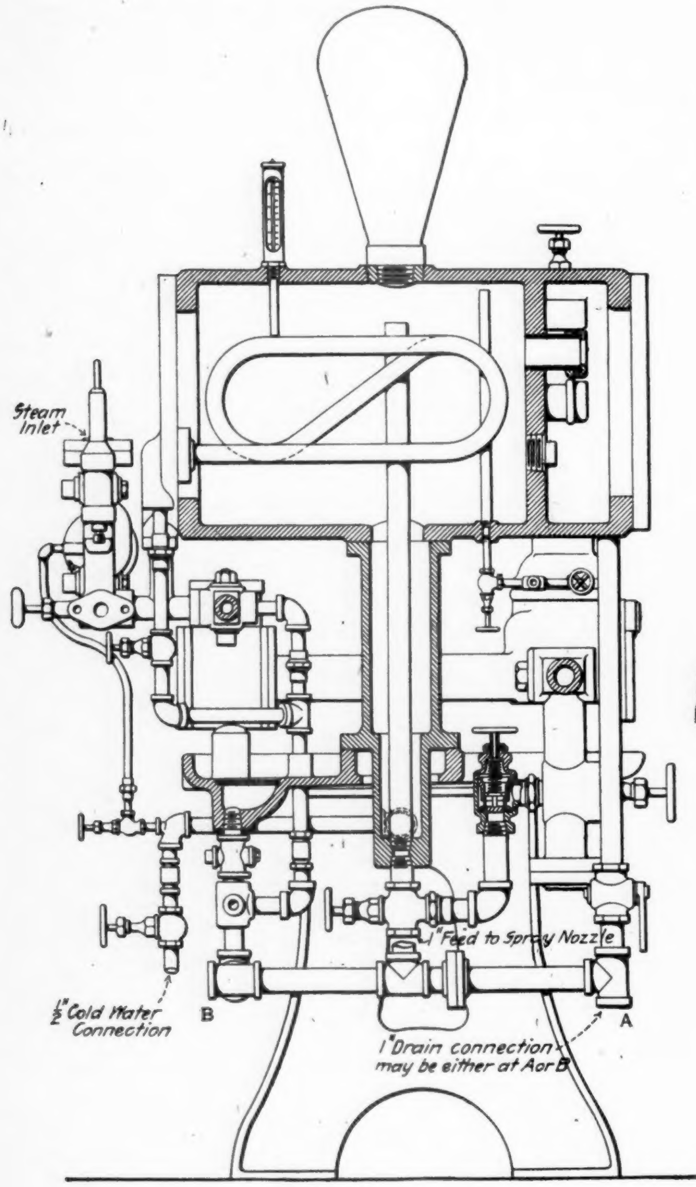


Fig. 6.

The governor consists of a cylindrical, partially balanced valve. The stem of this valve is attached to a copper diaphragm forming one side of a chamber which contains water, and which is in pipe communication with the receiver. The receiver pressure is thus transmitted to one side of the diaphragm, and is balanced by an adjustable spring and system of levers on the opposite side. By tightening the spring, the pressure required to close the governor valve is increased, and an increased pressure is, therefore, maintained in the receiver.

The relief valve is placed in a pipe which connects the oil delivery pipe to the suction pipe, and is a disc valve held upon its seat by a helical spring which may be compressed by a hand wheel.

The piping to this oil system is so arranged that steam from the University power plant can be used to operate the pump and spray the oil in starting up, and until the steam pressure in the locomotive boiler has become high enough to do this work. When this condition is reached, steam from the locomotive can be used.

11. **Preparation of the Firebox.**—In preparing the firebox for oil fuel, the grate bars were removed, the bottom of the ash pan strengthened, and fire brick applied, all as shown by

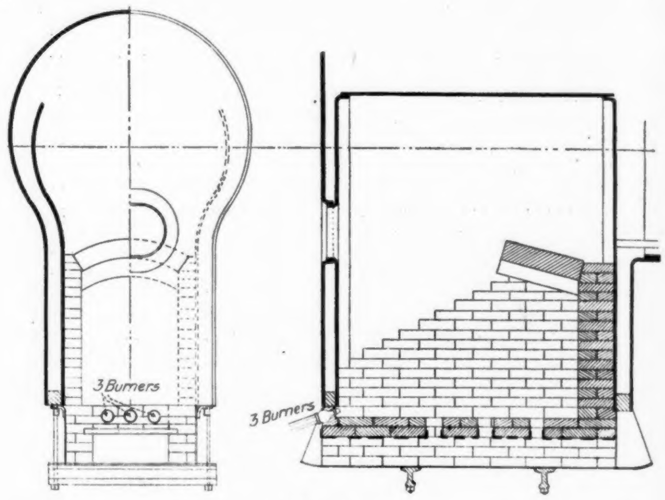


Fig. 7.

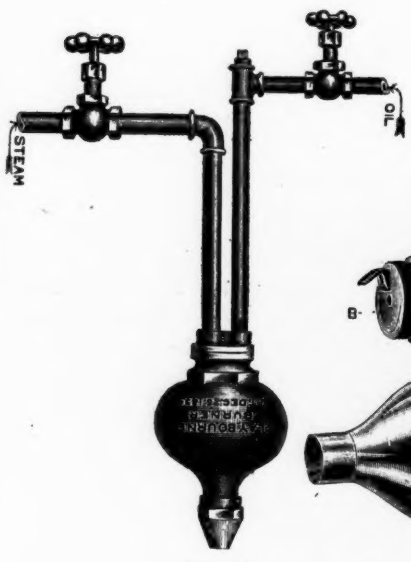


Fig. 8.

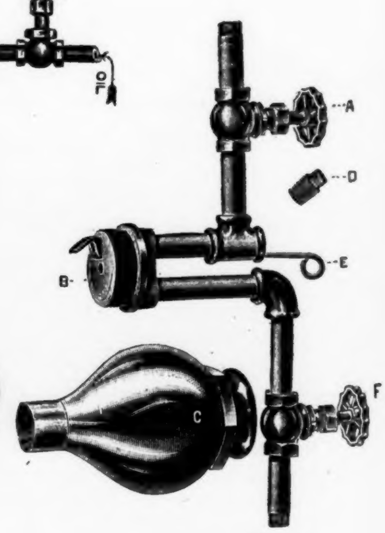


Fig. 9.

Fig. 7. In the design of this arrangement it was necessary to provide a furnace in which a good fire could be maintained and, also, one to which air would be admitted by openings of constant area. The necessity for maintaining the area of air openings constant has already been commented upon (paragraph 7). It arises from the fact that any change in the resistance to be overcome by air entering the furnace produces changes in the pressure within the smoke box, the observance of which constitutes an important factor in the present work.

The design shown was adopted after a considerable amount of preliminary experimentation. It was at first assumed that the maintenance of brick work in the bottom of the furnace would prove troublesome, and that the passage of air through portions of the bottom which were supposed to be closed, would be considerable and of varying amounts. To guard against this, the openings in the brick work were first made of liberal

area, and the whole ash pan was enveloped in a light structure of galvanized iron having a single opening in the bottom. The use of this enveloping structure required all air on its way to the firebox to pass an opening in a metal plate, the area of which would, of course, be in no danger of undergoing changes as the test proceeded. After repeated trials and several changes in the extent and location of the air opening, the use of this air box was reluctantly abandoned, the conclusion being that the most liberal dimensions in such a structure were not sufficient to prevent its presence from producing an unfavorable effect upon the steadiness of the fire. In the arrangement finally adopted (Fig. 7), the bottom of the furnace is made up of two courses of fire brick well bonded. The air openings are narrow and extend the full breadth of the furnace, thus permitting the brick work which bounds them to be laid in masses which are comparatively large and strong. Each brick was dipped in fire clay as laid. The edges of the openings are bounded by angle iron. This construction, while possibly open to some criticism, seems nevertheless to be as secure as could readily be obtained. As a practical matter, it appeared throughout the test to serve well its intended purpose. In the beginning of the work, the ports for the admission of air were accurately measured, and as the work proceeded they were frequently verified, and, when necessary, they were corrected.

12. Size of the Air Opening.—In the preliminary discussion of the experiment by the railroad representatives and other gentlemen interested, it was suggested that the area of the air opening should be the same as that which was employed in the Von Borries-Troske tests. It is fair to presume that the purpose of this suggestion was to insure conditions of draft in combination with similar volumes of air, which would be comparable with those of the Von Borries-Troske tests. A moment's reflection will show that the conditions of service such as those under which the Purdue experiments were made, are altogether at variance with those surrounding the Von Borries-Troske tests. In the actual engine there is added to the resistance of any orifice which may be employed the resistance of the firebox and of the tubes, and if the same volume of air or gases are to reach the smoke box of the actual engine, the orifice at the ash pan must of necessity be larger than that which was employed in the Von Borries-Troske experiments. In general it may be said that as the number of the resistances to the passage of air, in its course from the atmosphere to the smoke box, increases, the area of the various openings along the way must be increased. To have made the results of the present tests strictly comparable with those of the Von Borries-Troske tests, effort should have been made, not to employ equal areas, but equal resistances to the movement of air into the smoke box. Difficulties in doing this are great, and consequently no serious effort has been made to duplicate the Von Borries-Troske tests in this respect.

The size of the openings actually employed were determined from the condition of the fire. The purpose of admitting air is to sustain combustion and the work proceeded on the assumption that as little air should be admitted as is consistent with satisfactory furnace conditions. It was assumed, also, that for the present purpose it would be sufficient to fix the area for one condition of running, since as the power of the engine was increased, and there was necessity for admitting larger quantities of air, the draft became greater and the movement of air through the fixed opening more rapid.

The area of the air ports finally settled upon amounted to 196 sq. ins. Under all but the heaviest conditions of running the discharge from the stack was colorless, but with this opening at the grate there was some smoke when the fire was very heavy.

13. Burners.—The oil burner was placed below and in contact with the mud-ring and inclined upward at an angle about as shown in Fig. 7. An attempt was first made to use the Booth burner, which has been described. (American Engineer, December, 1901, page 388.) A burner of this type with its accompanying heater was supplied through the courtesy of Mr. G. R. Henderson, superintendent motive power of the Atchison, Topeka & Santa Fe Railway. This burner discharges oil in the form of a broad stream, which falls upon and is atomized by a ribbon of steam beneath. Its capacity is enormous, and whenever the conditions were such as to permit the carrying of a heavy fire, its work was satisfactory. The proportions of the burner in question were evidently such as to adapt it for use upon a much larger engine than that which was employed in the experiments, and for this reason the performance of the burner under the conditions of the tests under consideration was not entirely satisfactory. For much of the work it was necessary to maintain a light fire. An attempt to do this with the Booth burner resulted in an unsteady flame, and after some experimenting it was thought best to discontinue the use of this form of burner. The abandonment of the Booth burner reflects no discredit upon this burner, the fact being that the apparatus in question was much more powerful in action than anything which we could use.

After the removal of the Booth burner, three burners of smaller capacity were substituted. These were supplied through the courtesy of the Claybourne Burner Company, of Chicago. They were so connected that either one, two or three could be employed, depending upon the amount of power required. The manner of their application is well shown by Fig. 7. The presence of the three burners gave an element of flexibility which, under the conditions of the laboratory, greatly contributed to ease in firing. Generally one burner was used in raising steam and for a light power, and two burners were found to suffice under almost all conditions of running.

The general form of the Claybourne burner is shown by Fig. 8. The oil and steam are intimately mixed in a spherical mixing chamber, the oil being fed from a pressure of about 25 lbs. or less through an orifice of about one-eighth of an inch in diameter. Fig. 9 shows the arrangement of the several parts. The oil stream is deflected by a shield above the orifice and is thus brought in contact with the jet of steam which emerges from the center of the fitting which closes the base of the burner.

(To be continued.)

---

"By watching small items," says a writer in "Railway Machinery"; "considerable reduction in cost of operation may be accomplished." After surveying the record of the past year he prepared a system of handling work so as to have no superfluous men. Laborers were put on rough work and a piecework price determined, for those who left were not replaced. This made the laborers earn their own wages instead of the machinist earning it for them. A saving was effected by the systematic picking up of nuts, retapping those which could be used again, and scrapping the rest. Engines in for repairs were credited with scrap at prevailing prices, and a careful supervision was exercised to see that what could be worked up again was not scrapped, thus decreasing the demand for new material. The working up of templates, air appliances, and other methods of quickly and cheaply handling material were introduced. The net result of these reforms in "little things" gave an increase of 18 engines reported for service, and an actual total decrease in expenses over the previous year of $4,042. There were 18 more days worked, which, at an average of $114 per day, showed a net decrease of $6,094 for the same number of days.

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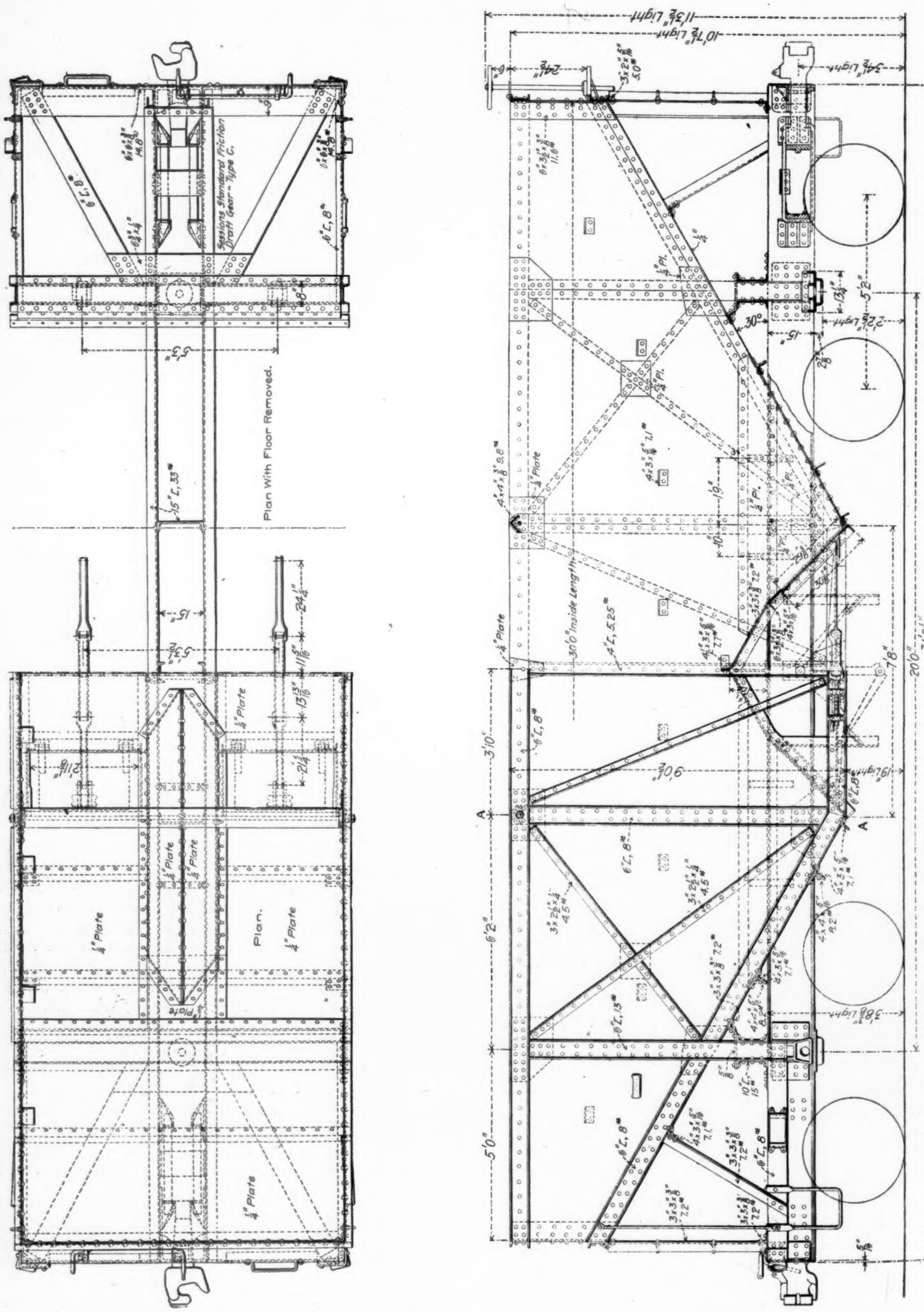
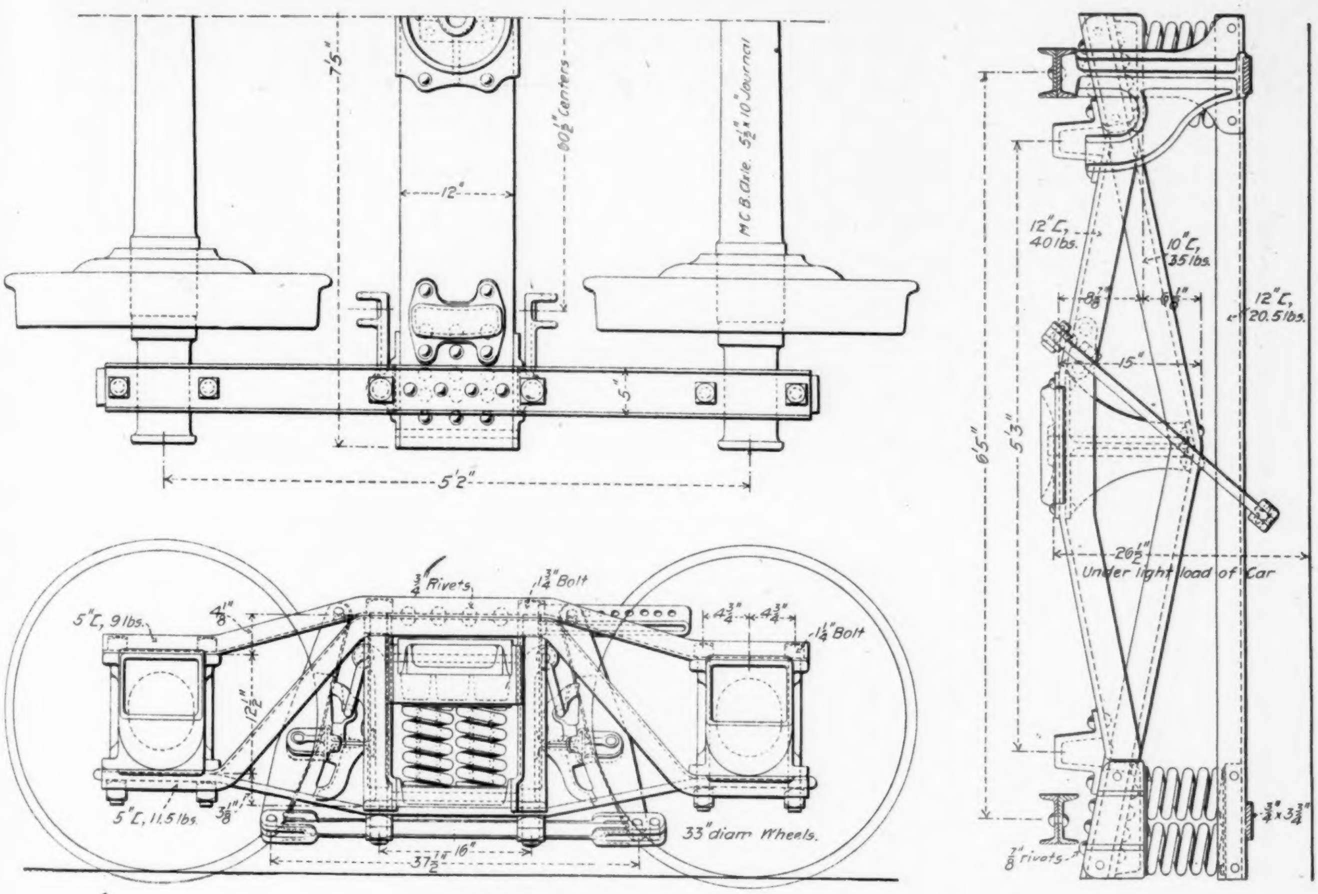
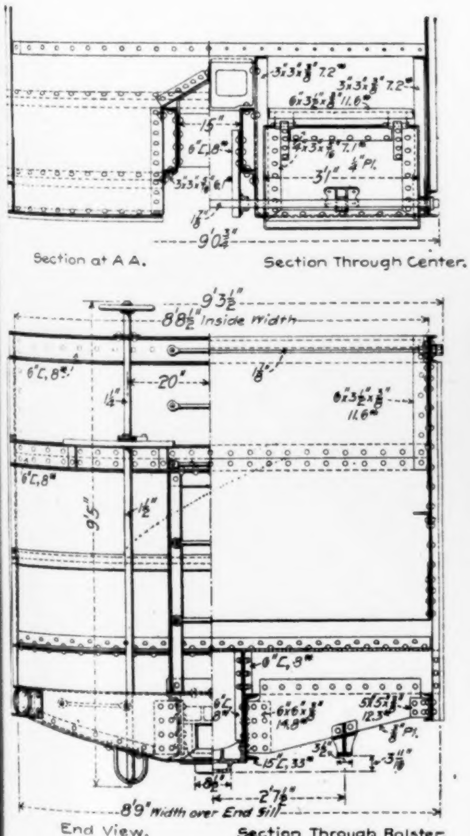
It is stated, on the authority of Mr. J. Kruttschnitt, of the Southern Pacific, that that road is likely to adopt fuel oil for all the locomotives of the entire line.




100,000 Pounds Capacity Hopper Coal Car—West Virginia Central & Pittsburg Railway. Designed by Cornelius Vanderbilt, M. E.




Vanderbilt Compression Arch Bar Truck.




Transverse Section and End View.

From a Photograph.

**100,000 POUNDS CAPACITY HOPPER COAL CAR.**

**West Virginia Central & Pittsburgh Railway. Designed by Cornelius Vanderbilt, M. E.**

## VANDERBILT 50-TON HOPPER COAL CAR.

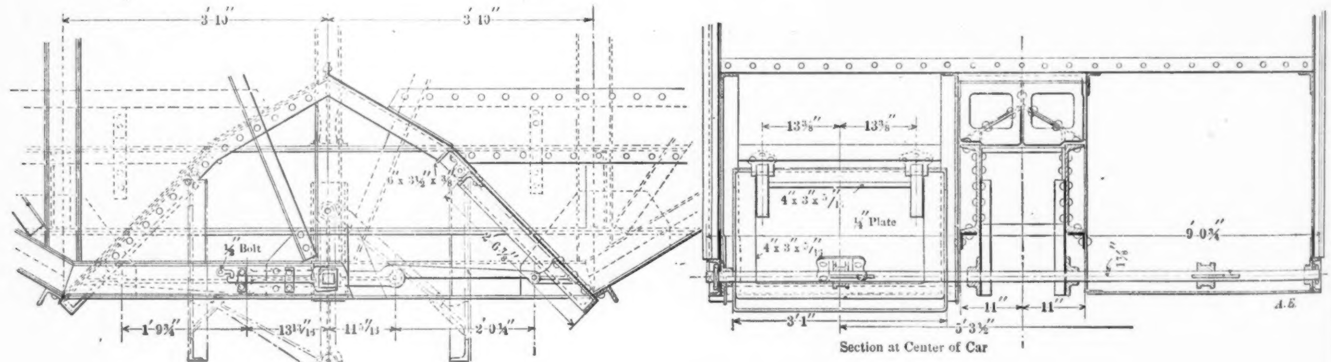
### West Virginia Central & Pittsburgh Railway.

These drawings illustrate the construction of 800 steel hopper cars of 100,000 lbs. capacity, designed by Cornelius Vanderbilt, M. E., which are now being built for the West Virginia Central & Pittsburgh Railway. In our November number of last year, page 338, we illustrated the experimental car by Mr. Vanderbilt, and the present construction embodies the development of the ideas of the earlier design.

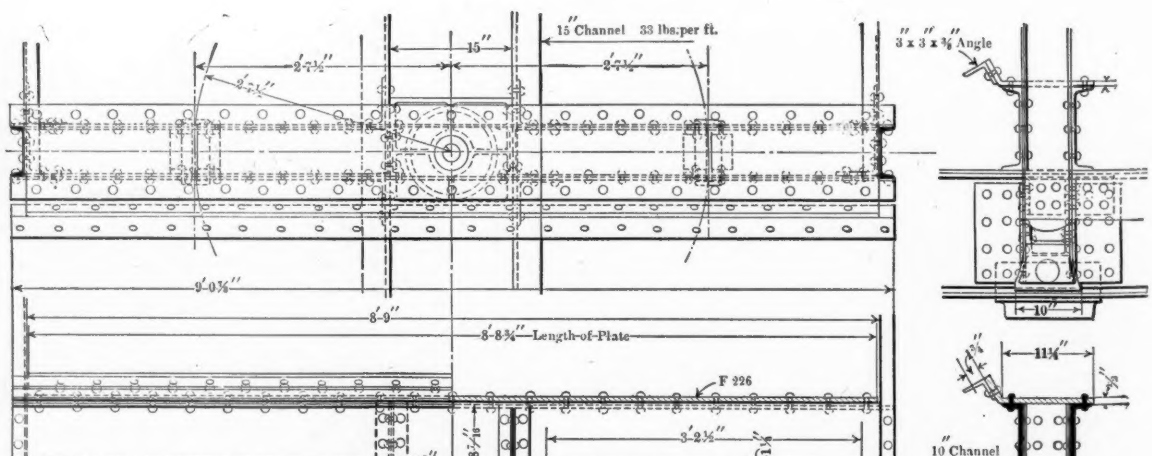
In the first cars, for the Lackawanna Iron & Steel Company, it was decided to employ small center sills in the form of 9-in. channels, 25 lbs. per ft., and these cars will be watched with interest on that account, if for no other reason. The present construction employs 15-in. channels of 33 lbs. per ft., and these center sills form the backbone of the car. Instead of channels for end sills this car employs 5-16-in. plates with a top flange 9 ins. wide, which acts as a gusset to strengthen the connections between the center sills and the diagonal end sill braces. Angles are riveted to the bottom of these plates. End sill braces extend from the end sill to the body bolsters, and are there secured to the car body supports as well as to the body bolsters. The car body supports are vertical posts at the ends of the bolsters. The body bolsters are two 10-in. channels, resting on top of the center sills and secured at their ends to the car body supports. Two ⅜-in. plates are riveted to the webs of these channels, extending the depth of tne center sills and secured thereto by means of angles. To these bolster plates the body side bearings are secured by rivets. The end framing is further strengthened by angles

TABLE COMPARING LARGE CAPACITY CARS.

| TYPE. | OWNER. | Light Wt., Lbs. | Load Limit, | Length, Inside, ft. in. | Width, Inside. ft. in. | Height, top of rail, top of side. ft. in. | Capacity, level full, cu. ft. | Capacity. 30° heap. cu. ft. | Capacity, lbs., coal level 52 cu. ft. | Capacity coal, 30° heap, at 5[illegible] lbs. |
|---|---|---|---|---|---|---|---|---|---|---|
| Pressed Steel, | L. S. & M. S. | 36,600 | 110,000 | 30 0¼ | 9 6 | 10 0 | 1,680 | 2,030 | 87,360 | 103,560 |
| " " | Erie | 36,300 | 110,000 | 30 0¼ | 9 6 | 10 0 | 1,680 | 2,030 | 87,360 | 103,560 |
| " " | P. R. R. | 39,600 | 110,000 | 31 6⅛ | 9 6 | 10 0 | 1,685 | 2,056 | 87,620 | 106,912 |
| " " | L. V. R. R. | 37,600 | 110,000 | 30 0¼ | 8 6 | 10 2½ | 1,738 | 2,088 | 90,376 | 108,576 |
| Structural Steel, | L. S. & M. S. | 38,300 | 110,000 | 32 0 | 9 0 | 11 7⅝ | 1,800 | 2,140 | 93,600 | 111,280 |
| Vanderbilt, | Lackawanna, I.&.S.Co. | 37,000 | 120,000 | 30 0 | 9 0 | 11 3 | 1,822 | 2,136 | 94,744 | 111,072 |
| Pressed Steel, | B. & O. | 36,700 | 110,000 | 30 0¼ | 8 8½ | 10 7½ | 1,590 | 1,886 | 82,680 | 98,072 |
| Structural Steel, Vanderbilt, | W. Va., C. & Pg. | 36,500 | 120,000 | 30 0⅛ | 8 8½ | 10 7½ | 1,594 | 1,889 | 82,888 | 98,228 |




Hopper Door Mechanism.




Views of the Body Bolster.

THE VANDERBILT 50 TON HOPPER COAL CAR.

extending from the end sill braces to the under side of the car body. The corners of the body are securely held together by heavy angles instead of channels, as in the experimental car. For the corner bracing of the end sills 6-in. channels are used, extending from the end sill plates to plates resting on the top flanges of the center sills at the body bolsters. Instead of the diagonal floor supports of the earlier car this one has angles extending straight across the car body, the long legs of which extend downward. The body center plates are 10¾ ins. in diameter, and have a 13¼ in. bearing on truck center plates. The center sill cover plates, instead of being riveted to the top flanges of the center sills, are riveted to the plates which form the hopper sides. The following table gives the principal dimensions of the car:

VANDERBILT FIFTY-TON HOPPER CAR.

| | |
|---|---|
| Light weight, estimated | 36,500 lbs. |
| Maximum capacity | 120,000 lbs. |
| Length inside of body | 30 ft. |
| Width inside body | 8ft. 8½ ins. |
| Length over all | 31 ft. 10 ins. |
| Width over all | 9 ft. 3⅞ ins. |
| Height over brake staff (light) | 11 ft. 3½ ins. |
| Height over car body | 10 ft. 7½ ins. |
| Height to bottom of hopper | 1 ft. 7 ins. |
| Height to top of sills | 3 ft. 8⅜ ins. |
| Maximum capacity, 30 deg. heap | 1,889 cu. ft. |
| Capacity level full | 1,594 cu. ft. |
| Capacity, coal at 52 lbs. per cu. ft. | 98,228 lbs. |

The truck is of the arch bar type, a combination of a recently patented diamond type using channel arch bars with Commonwealth Steel Company's end castings and Crone rocker side bearings. When the car is carrying its maximum load of 120,000 lbs. the bolster carries 72,000 lbs. The truck bolster has been patented by Mr. Vanderbilt. One of them was recently tested to 188,000 lbs.

Our engravings also illustrate Mr. Vanderbilt's arch bar truck with compression members, although the cars are not fitted with the truck which is shown in the engraving. The object of this design was to reduce weight in the trucks. Instead of being in tension the bottom arch bar is in compression. As a short strut, a channel is of greater value in compression than in tension.

These cars are equipped with the Sessions-Standard friction draft gear, type C, Tower couplers with 5 by 7 in. shanks, Vanderbilt structural brake beams, cast iron wheels, McCord journal boxes and lids, Corning insert brake shoes and steel castings from the Commonwealth Steel Company, of St. Louis. In the table on page 104 a comparison of the characteristics of a number of large capacity cars is given.

## NEEDED IMPROVEMENTS IN THE DESIGN OF DRAFT GEAR.

By R. A. Smart.

Some discussion has recently been indulged in concerning the damaging effects to freight cars of the failure of couplers and draft gear to permit of proper curving. It has been pointed out that while the contour lines laid down by the M. C. B. coupler committee provided for a maximum angle of 14°, there are many couplers in service and on the market to-day which do not curve more than 2 or 3°. In such cases, when the angle of a curvature allowed is less than the normal amount, serious strains are set up in forcing the couplers to greater angles than they will naturally allow, which strains are thought to be responsible for a good deal of the damage to equipment, usually attributed to other sources.

It has further been shown that even with proper contour lines the present draft arrangement leads to serious trouble with cars of unequal length on simple curves, cars of equal length on reverse curves, or in cases where one car is on a tangent and the adjacent car is on a curve. In such cases the center lines of adjacent cars at the point of coupling may not coincide by an amount greater than the side play allowed the coupler, thus throwing serious transverse stresses on the draft rigging at various points.

While it is quite likely that from time to time some improvements in methods of manufacture will be introduced which will result in closer conformity to the M. C. B. lines, it is improbable that perfect lines and the consequent maximum angle of curvature originally provided for will ever be realized on all couplers sold. And even though this result should be attained, it seems that we are always going to have trouble with draft gear, unless some radical method is adopted in the gear itself which will take the matter squarely in hand and rationally provide for the difficulty.

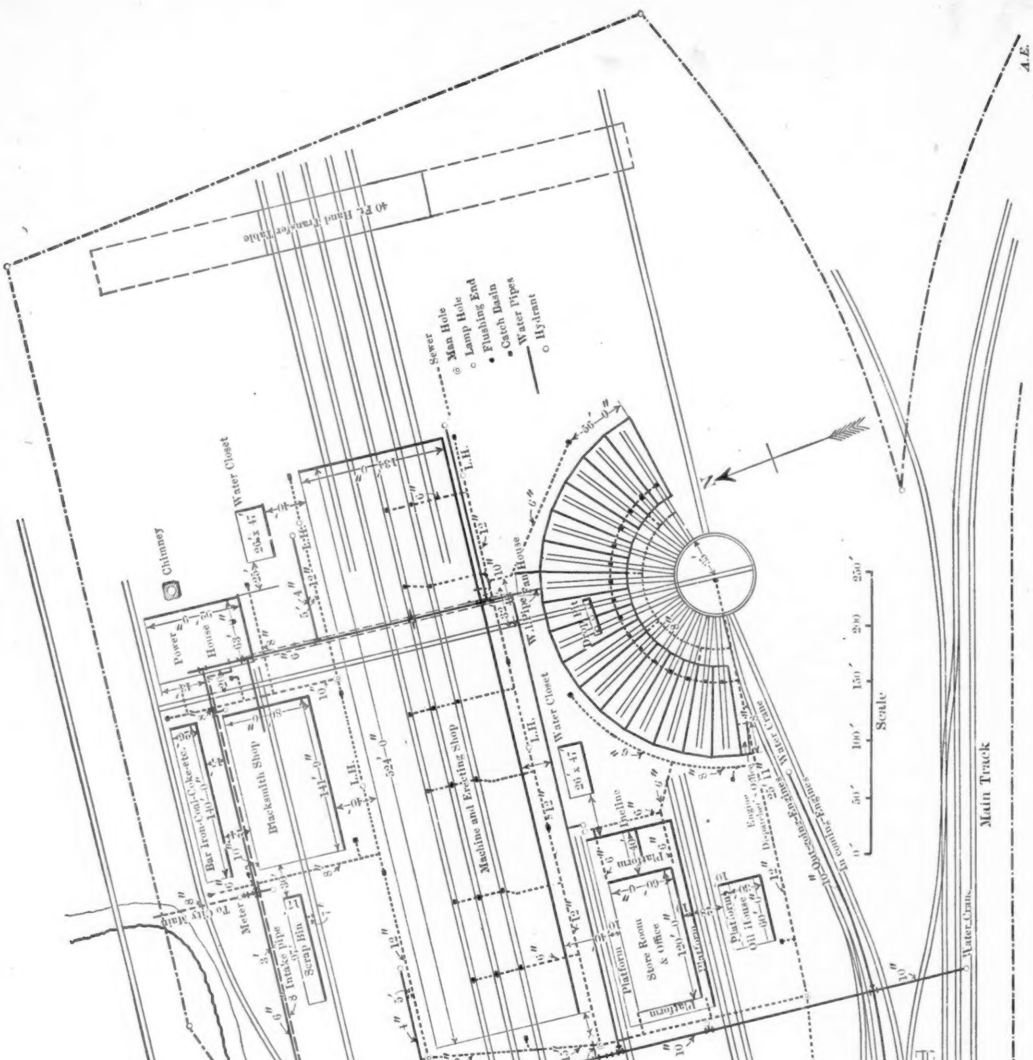
Opinions are not wanting from well-known authorities that the present design is adequate to meet all conditions. This seems very surprising, in view of the fact that evidences could be multiplied showing the damage inflicted, not only on couplers and draft gear themselves, but upon car bodies, truck frames and wheels. Many of these failures are attributed to other causes, such, for instance, as rough handling in the yards. The writer has, however, evidence that the real reason has in many instances been overlooked, and that the failure of couplers and draft rigging to curve properly is responsible for a great deal of damage.

It is well known that, in theory, the properly designed draft gear should be made to swing about the center of the truck, so that two adjacent coupler shanks will be in the same straight line. Why should not the actual design approximate somewhat to this ideal condition? Of course it will be urged that such a gear will be too complicated and costly to apply and maintain. If, however, the present design were charged with the full measure of responsibility for damage which is due it, there might appear good reason for some radical changes. A few years ago, no one would have predicted that complicated friction draft gears, such as are now being sold in large numbers, would ever be applied to freight cars. But there is now no question that for some classes of service they are a necessity. So it may be that a better general design of draft gear, although somewhat more expensive than the present form, would be economy in the end.

This subject has not received the attention which it merits, and it is one which is daily increasing in importance. It should be thoroughly discussed, with a view to either sustaining or disproving the charges preferred against the present design.

## MARCONI'S LATEST ACHIEVEMENT.

In an article by Mr. Wilfrid Blaydes, appearing in the "Electrical World and Engineer," a fac-simile of the tape record of what may be called a "Marconigram" is shown. The tape was indented by an ordinary Morse registering machine on board the S.S. "Philadelphia," when 2,099 miles distant from the sending station. After overhauling and testing his plant at Poldhu, Cornwall, Mr. Marconi arranged the details concerning messages which were to be sent after him as he sailed westward to America. From the first no doubt of their success was entertained, and the inventor found he did not require specially sensitive adjustments. The messages were always received in the presence of independent witnesses, and the tape records were attested by the ship's officers. What Mr. Marconi has accomplished has been done with a purely temporary installation at Poldhu, as far as aerial capacity is concerned. The electrical energy which has sufficed to send legible signals over 2,099 miles is about one-tenth of the supply which Mr. Marconi will have available as soon as the work of tower erection in England is completed. The tests on the "Philadelphia" show the nicety of "tuning" which has been achieved with these instruments. The "Umbria," which followed the "Philadelphia" across the ocean one day later, failed to receive one of the signals which were certainly passing over her.




**Locomotive Shops, Du Bois, Pa.—Buffalo, Rochester & Pittsburgh Ry.**

C. E. TURNER, *Superintendent Motive Power.* R. H. SOULE, *Consulting Engineer.* J. M. FLOESCH, *Chief Engineer.*

## NEW SHOPS AT DU BOIS, PENNSYLVANIA.

### Buffalo, Rochester and Pittsburgh Railway.

### Capacity, 200 Locomotives per Year.

These shops are specially interesting because the preliminaries and plans were drawn up by the motive power department of the B., R. & P. Ry., with the assistance of Mr. R. H. Soule, as consulting engineer, and Mr. William Forsyth, as mechanical engineer, although neither of these gentlemen followed them to completion.

The road is divided into the following principal operating divisions:

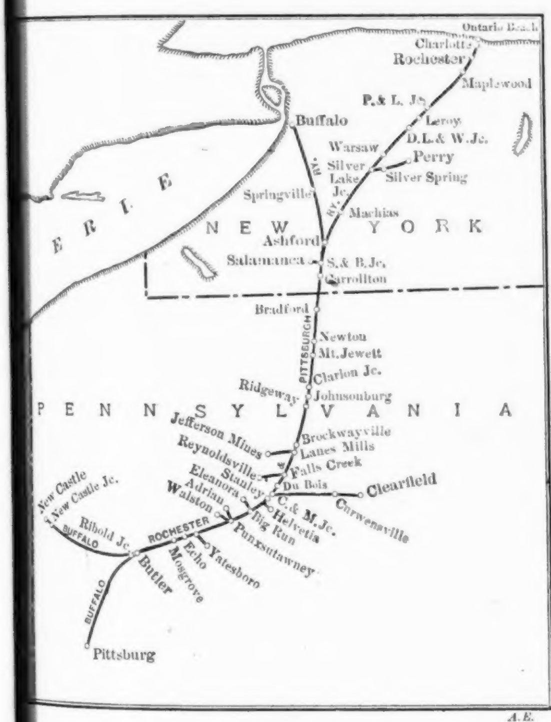
| Divisions. | Miles. |
|---|---|
| Rochester to Ashford | 94 |
| Buffalo to Bradford | 124 |
| Bradford to Punxsutawney | 104 |
| Reynoldsville to Clearfield | 38 |
| Punxsutawney to Butler | 62 |
| Butler to Newcastle | 40 |
| Butler to Allegheny (over B. & O. tracks) | |
| Punxsutawney to Coalfields | 40 |

The shops were located at Rochester, with facilities for an average of only about five engines per month for heavy and light repairs: Bradford, with a capacity of about seven engines per month, for lighter repairs, and Du Bois, about 1.5 engines per month, light repairs. The total capacity was about 14 engines per month for heavy and light repairs, and the southern portion of the road, as shown in the sketch map, was seriously handicapped for lack of shop facilities. In all there were but 5 shop pits for heavy repairs. Whatever may be done for future improvement at the north end of the road the territory naturally divides into two portions at Clarion Junction, and the new shops at Du Bois were planned to completely maintain all engines assigned to the middle, Clearfield and Pittsburgh divisions, and to do all new firebox work for the Rochester and Buffalo divisions; the Rochester and Buffalo shops to continue to deal with light repairs on the Rochester and Buffalo divisions, up to and including tire turning and flue renewals. At Du Bois 32 acres were available for the shop plant and yard, the location being in the heart of the coal fields.

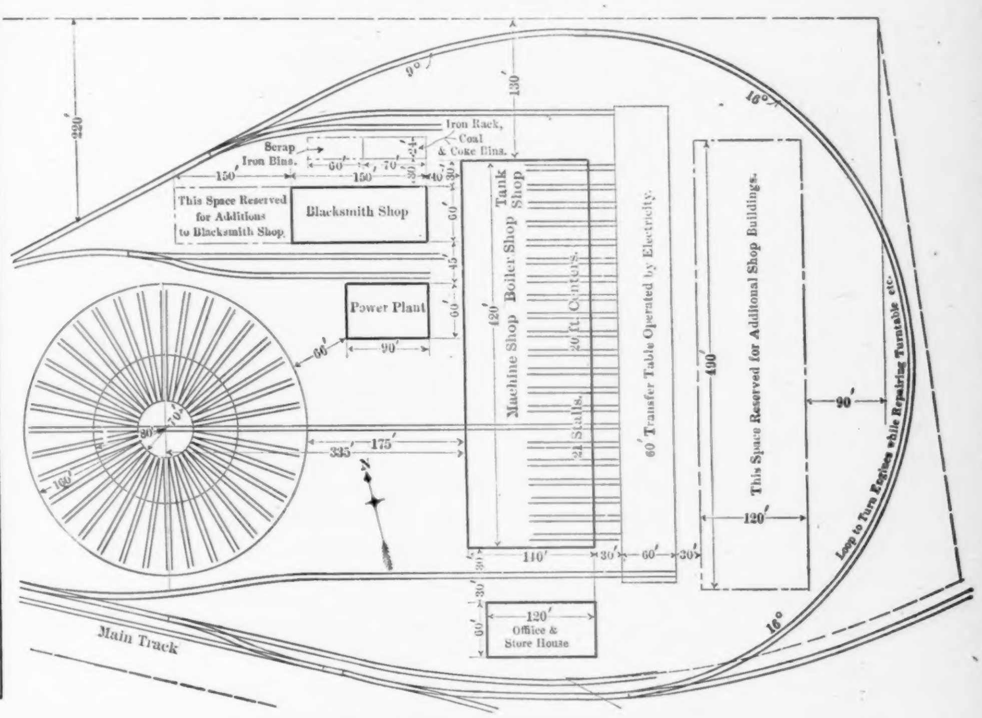
The total number of engines to be repaired at Du Bois each year was 147, out of a total of 209. Provisions for expansion for five years at 15 per year, or for 75 engines, were made, a total of 200 engines of which would be dependent upon the new shops, or 17 engines per month. With an allowance of 20 days for each engine in the shop, not including work which may have been done previously on the boiler in the boiler shop, each stall should turn out 1½ engines per month and 12 stalls would provide for 18 engines per month, which would be sufficient. The actual equipment at the present time includes:

| | | |
|---|---|---|
| 4 Atlantic type | 2.2 | per cent. |
| 8 American type | 4.4 | " " |
| 4 Switch engines | 2.2 | " " |
| 22 Ten-wheelers | 12. | " " |
| 65 Moguls | 13.6 | " " |
| 25 Consolidations | 25.5 | " " |
| 55 Twelve-wheel | 30.1 | " " |

The total is 183, and 20 additional engines are maintained by this road. The average weight is 130,000 pounds, and the average tractive power 25,000 pounds. There are now on order 10 twelve-wheel engines of 170,000 pounds, having 33,700 pounds tractive power, and 10 consolidation engines of 180,000 pounds and 41,100 pounds tractive power. It was assumed that about one-third as many boilers as engines would be under repair at one time, or 6 boilers, and the same was applied to tanks. For 12 engines at 45 ft., 6 boilers at 35 ft., and 6 tanks at 30 ft., 930 ft. of track room would be required. A two track shop would need to be 465 ft. long, and a three track shop 450 ft. It was decided to use a length of 524 ft. and a "longitudinal" track arrangement was decided upon, although a plan for a "transverse" track shop was made by the officers of the road for comparison of the two systems. An opportunity to compare the two systems seldom presents itself and both plans are presented here as a study.




Map of B., R. and P. Ry.




The Proposed Transverse Plan.

LOCOMOTIVE SHOPS AT DU BOIS, PA., BUFFALO, ROCHESTER AND PITTSBURGH RAILWAY.

### The Transverse Plan.

This is termed the "old" plan. It was believed to furnish the best facilities for the least cost, and to provide for ample

extensions. The distances from shop to shop were not believed to be materially affected by the track arrangement inside the erecting shop. In this plan all the buildings may be extended. Particular stress was laid on the short distance between the locomotives on the erection floor and the machine shop, this being considered more vital than any other distance. In fact, all the distances from the machine shop to various other departments were made low, and this is made clear in the tabular comparison which follows, although other transporting distances about the plant are somewhat greater in this plan than in the other. It is worthy of note that with the exception of the distance from the erection shop to the roundhouse, the distances from that shop are lower when expressed in a total than in the longitudinal plan. By moving the roundhouse nearer the other buildings these distances would have been much less.

The advocates of the old plan question the advisability of adding greatly to the length of shops, because of increasing the distances from the engines to the machines and upsetting the internal arrangements. This plan employs but one crane instead of two, but obviously two, one heavy and one light, could be used, and in either case a number of small post cranes for the machine shop are required. For convenience in crossing the shop the passages are frequent and parallel in this plan, which was considered exceedingly important. In a transverse shop the height of crane lift for the large crane is lower than in the other, because the engines are not lifted over each other. For this reason the erecting shop may be placed next to the wall of a shop, the central bay of which is higher than the side bays. And in any case the cranes may be carried on comparatively low runways.

### The Longitudinal Plan.

The distance from shop to shop, measured from center to center, when taken as a whole, are less in the "new" plan, which was adopted by recommendation of Mr. Soule. All of the buildings may be extended. This plan does not depend upon the transfer table (and in fact the one shown may never be built). Every part of the yard space is available from some track. Engines may be brought directly to the shop and delivered directly therefrom, without the transfer table process. Two cranes are required to lift an engine, but they are also available for continuous use. The roof truss spacing is independent of the location of the engines and may be made to suit the roof independently of other considerations.

In this comparison of distances between the old and new plans all the measurements are taken between the centers of the spaces. It should be carefully studied in order to note the relative importance of the distances, because the totals do not in all cases tell the story.

### The Adopted Plan.

The machine, boiler and tank shops are provided for in a building 134 x 524 ft. in size, the blacksmith shop is 80 x 141 ft., the power house 63 x 93 ft., the office and storehouse 60 x 120 ft., and in addition to these is a 30 x 60 ft. oil house, a 16 stall roundhouse and a 26 x 140 ft. coal, coke and bar iron storage. A straight track runs from the roundhouse across the entire shop space, with turntables for connection to the blacksmith shop and yard tracks. A straight tunnel for pipes and wires extends from the power house to the roundhouse and drains toward the roundhouse. The plant is lighted and driven by electricity. These and the special features of the buildings will be described and illustrated in detail in future issues of this journal.

We acknowledge the kind assistance of Mr. C. E. Turner, superintendent of motive power; Mr. F. D. Hyndman, master mechanic, and Mr. W. R. Maurer, chief draftsman of this department, in connection with this description.

**B. R. & P. R. R. DU BOIS SHOPS.**

**Comparison of Distances, Old and New Plans.**

| | "Old" or Transverse Plan, feet. | "New" or Longitudinal Plan, feet. |
|---|---|---|
| From Roundhouse of Turntable to Machine shop | 450 | 275 |
| " " " " " Boiler shop | 510 | 395 |
| " " " " " Erecting shop | 510 | 270 |
| " " " " " Blacksmith shop. | 350 | 380 |
| " " " " " Storehouse | 530 | 295 |
| Totals | 2,350 | 1,610 |
| From Machine Shop to Roundhouse | 450 | 275 |
| " " " " Boiler shop | 240 | 430 |
| " " " " Erecting shop | 60 | 240 |
| " " " " Blacksmith shop | 310 | 250 |
| " " " " Storehouse | 210 | 410 |
| Totals | 1,270 | 1,605 |
| From Boiler Shop to Roundhouse | 510 | 395 |
| " " " " Machine shop | 240 | 430 |
| " " " " Erecting shop | 240 | 190 |
| " " " " Blacksmith shop | 200 | 240 |
| " " " " Storehouse | 440 | 140 |
| Totals | 1,630 | 1,395 |
| From Erecting Shop to Roundhouse | 510 | 270 |
| " " " " Machine shop | 360 | 240 |
| " " " " Boiler shop | 240 | 190 |
| " " " " Blacksmith shop | 220 | 120 |
| " " " " Storehouse | 220 | 200 |
| Totals | 1,250 | 1,020 |
| From Blacksmith Shop to Roundhouse | 350 | 370 |
| " " " " Machine shop | 310 | 250 |
| " " " " Boiler shop | 200 | 240 |
| " " " " Erecting shop | 220 | 125 |
| " " " " Storehouse | 480 | 300 |
| Totals | 1,560 | 1,285 |
| From Storehouse to Roundhouse | 530 | 290 |
| " " " Machine shop | 210 | 410 |
| " " " Boiler shop | 440 | 140 |
| " " " Erecting shop | 220 | 200 |
| " " " Blacksmith shop | 480 | 300 |
| Totals | 1,880 | 1,340 |

**Summary of Total Distances.**

| | | |
|---|---|---|
| From Roundhouse | 2,350 feet. | 1,610 feet. |
| " Machine shop | 1,270 " | 1,605 " |
| " Boiler shop | 1,630 " | 1,395 " |
| " Erecting shop | 1,250 " | 1,020 " |
| " Blacksmith shop | 1,560 " | 1,285 " |
| " Storehouse | 1,880 " | 1,340 " |
| Totals | 9,940 " | 8,255 " |

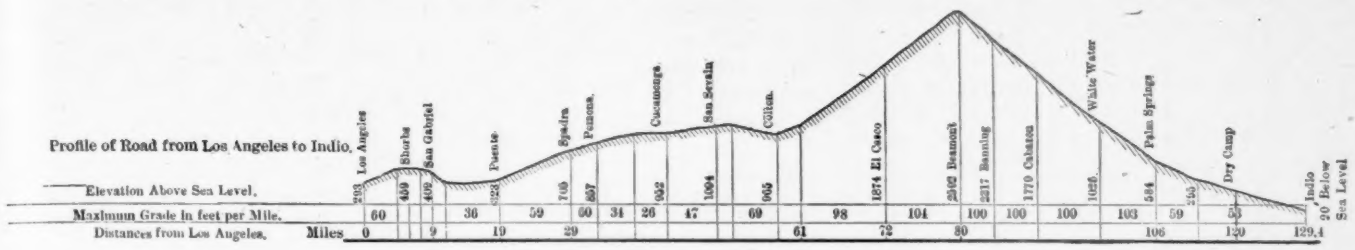
## COMPARATIVE TESTS OF OIL BURNING LOCOMOTIVES, SOUTHERN PACIFIC RAILWAY.

Mr. H. J. Small, superintendent motive power of the Southern Pacific, has sent us an interesting account of tests made recently on that road with oil fuel on a Cooke simple engine and a Vauclain compound having a Vanderbilt firebox. These tests were very carefully made under the personal direction of Mr. H. Stillman, engineer of tests, and they represent the best practice in oil burning on locomotives. Engine No. 1723 is a Vauclain compound with a Vanderbilt firebox. Engine No. 1625 is a simple engine, with an ordinary firebox, built several years ago by the Cooke Locomotive Works. The tests covered two round trips with each engine between Los Angeles and Indio, under ordinary service conditions as is usual in such tests, and the conditions were as nearly alike as the traffic would allow. The profile of the road is given in the accompanying diagram.

The compound engine with the Vanderbilt boiler showed an advantage of 9.42 per cent. in equivalent evaporation, 17 per cent. in ton miles per gallon of oil and 7 per cent. in ton miles per gallon of water, these figures being based upon the totals and averages. Mr. Small states that the Vanderbilt style of boiler shows every evidence of proving to be a satisfactory one for oil burning, from the fact that there is an entire absence of seams, staybolts, or crown bolts in the furnace to be affected by the extreme heat generated, which in an ordinary firebox causes more or less trouble from leakage.

The Kern River fuel oil had the following characteristics:

| | |
|---|---|
| Gravity | .969 or 14½ Baume. |
| Flash point | 240 deg. F. |
| Fire point | 280 deg. F. |
| Commercial weight | 8 lbs. per gal. |




**Profile of Southern Pacific, Los Angeles to Indio.**

SERVICE TESTS, SIMPLE AND COMPOUND MOGUL LOCOMOTIVES ON LOS ANGELES DIVISION, JANUARY, 1902. OIL BURNING.

TWO ROUND TRIPS EACH ENGINE BETWEEN LOS ANGELES AND INDIO.

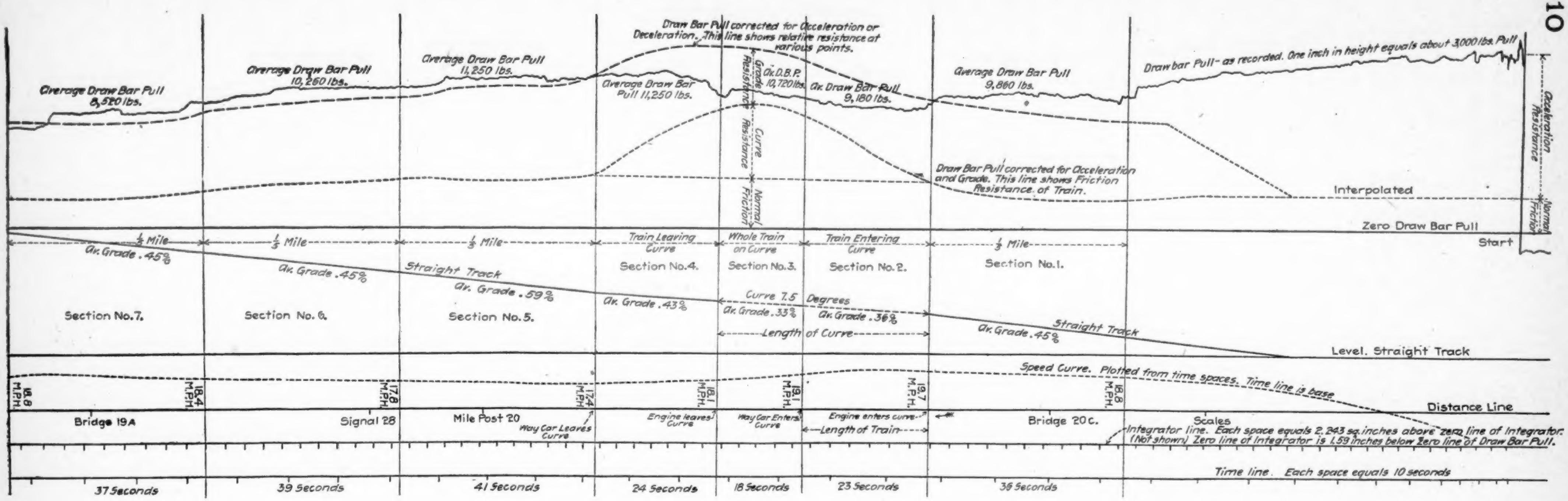
| | | | | | | |
|---|---|---|---|---|---|---|
| Number of test | 1 | 2 | 3 | 4 | Totals and Averages. | |
| Number and class of engine | 1625 | Class E. D. | 1723 | Class E. F.—1 | 1625 E. D. | 1723 E. F.—1 |
| Builder and kind of engine | Cooke. | Simple. | Baldwin. | Compound. | Simple. | Compound. |
| Size of cylinders | 20 by 28 | | 15½ and 26 by 28 | | 20 by 28 | 15½ and 26 by 28 |
| Location of test | Los Angeles to Indio. | Indio to Los Angeles. | Los Angeles to Indio. | Indio to Los Angeles. | Two round trips. between Los Angeles and Indio. | |
| Date of test | Jan. 21 & 23. | Jan. 22 & 24. | Jan. 14 & 16. | Jan. 15 & 17. | | |
| Number of train, through freight | 244 | 243 & ext. West. | 244 | 243 | | |
| Kind of oil fuel | | Kern | River District. | | | |
| Schedule time between terminals | 19 hrs. 10 min. | 20 hrs. 0 min. | 19 hrs. 10 min. | 20 hrs. 0 min. | 39 hrs. 10 min. | 39 hrs. 10 min. |
| Total time of test | 18 hrs. 49 min. | 22 hrs. 21 min. | 19 hrs. 23 min. | 20 hrs. 0 min. | 41 hrs. 10 min. | 39 hrs. 23 min. |
| Actual running time | 13 hrs. 28 min. | 14 hrs. 2 min. | 13 hrs. 54 min. | 14 hrs. 4 min. | 27 hrs. 30 min. | 27 hrs. 58 min. |
| Time lost during test (standing) | 5 hrs. 21 min. | 8 hrs. 19 min. | 5 hrs. 29 min. | 5 hrs. 55 min. | 13 hrs. 40 min. | 11 hrs. 24 min. |
| Mean running time between terminals, M. P. H. | 19.3 | 18.5 | 18.7 | 18.5 | 18.9 | 18.6 |
| Number of stops made | 24 | 33 | 24 | 31 | 28.5 | 27.5 |
| Maximum steam pressure (gauge) | 188 lbs. | 187 lbs. | 199 lbs. | 198 lbs. | 188 lbs. | 199 lbs. |
| Minimum steam pressure (gauge) | 160 lbs. | 135 lbs. | 173 lbs. | 167 lbs. | 135 lbs. | 167 lbs. |
| Average steam pressure (gauge) | 178 lbs. | 179 lbs. | 188 lbs. | 184 lbs. | 178½ lbs. | 186 lbs. |
| Maximum temperature of smoke box | 800 degs. F. | 763 degs. F. | 675 degs. F. | 700 degs. F. | 800 degs. F. | 700 degs. F. |
| Mean temperature of smoke box | 665 degs. F. | 658 degs. F. | 619 degs. F. | 625 degs. F. | 662 degs. F. | 622 degs. F. |
| Mean temperature of feed water | 60 degs. F. | 60 degs. F. | 60 degs. F. | 60 degs. F. | 60 degs. F. | 60 degs. F. |
| Gallons of water evaporated | 25,732 | 30,286 | 24,979 | 29,150 | 26,018 | 54,129 |
| Pounds of water evaporated | 214,429 | 252,379 | 208,162 | 242,913 | 466,808 | 451,075 |
| Gallons of oil burned | 2,510 | 2,969 | 2,235 | 2,603 | 5,479 | 4,838 |
| Pounds of oil burned | 20,078 | 23,752 | 17,880 | 20,824 | 43,832 | 38,704 |
| Pounds of water evaporated per pound of oil | 10.68 | 10.62 | 11.642 | 11.66 | 10.65 | 11.654 |
| Equivalent water evaporated from and at 212 degs. F. | 12.921 | 12.825 | 14.087 | 14.12 | 12.885 | 14.101 |
| Pounds of water evaporated per gallon of oil | 85.44 | 84.96 | 93.136 | 93.28 | 85.20 | 93.232 |
| Equivalent water evaporated from and at 212 degs. F. | 110.54 | 102.26 | 112.70 | 112.92 | 105.080 | 112.81 |
| Gallons of water evaporated per gallon of oil | 10.25 | 10.20 | 11.176 | 11.198 | 10.226 | 11.188 |
| Equivalent water evaporated from and at 212 degs. F. | 12.40 | 12.34 | 13.523 | 13.550 | 12.37 | 13.537 |
| Pounds of water evaporated per square foot heating surface per hour | 5.39 | 5.34 | 4.64 | 5.19 | 5.36 | 4.92 |
| Pounds of water evaporated per square foot, equivalent per hour | 6.526 | 6.46 | 5.614 | 6.280 | 6.486 | 5.956 |
| Engine miles run per 1,000 gallons oil | 103.5 | 87.5 | 115.79 | 99.42 | 95.03 | 107.00 |
| Engine miles run per 1,000 gal. water. | 10.06 | 8.54 | 10.37 | 8.878 | 9.24 | 9.562 |
| Number of loaded cars in train (mean) | 30.5 | 180 | 33.6 | 28.4 | 24.2 | 31 |
| Number of empty cars in train (mean) | 3 | 22.7 | 1.5 | 5.2 | 12.8 | 3.3 |
| Total number of cars in train (mean). | 33.5 | 40.7 | 35.1 | 33.6 | 37 | 34.3 |
| Weight of train in M's (mean) | 1,692 | 1,664 | 1,681 | 1,788 | 1,678 | 1,735 |
| Weight of train in tons (mean) | 846 | 832 | 840.5 | 894 | 839 | 867 |
| Distance run, miles | 258.8 | 258.8 | 258.8 | 258.8 | 517.6 | 517.6 |
| Gross ton mileage | 219,114 | 215,322 | 217,690 | 231,546 | 434,436 | 449,236 |
| Ton miles per gallon of water | 8.434 | 7.107 | 8.712 | 7.942 | 7.752 | 8.296 |
| Ton miles per gallon of oil | 87.34 | 72.49 | 97.40 | 88.946 | 79.31 | 92.849 |
| Ton miles per pound of oil | 10.92 | 9.06 | 12.18 | 11.118 | 9.79 | 11.606 |

In the accompanying table the data and results of the tests are given. The train weights do not include the engine and tender. Helper engine mileage is allowed for in the gross ton mileage. The water evaporation per square foot of heating surface per hour includes the total time of the tests. The form of oil burner used in the tests was the "Sheedy," with the Southern Pacific furnace and draft appliances.

The weight of the compound engine is 176,640 pounds, with 153,880 pounds on the drivers and 22,760 pounds on the trucks. The heating surface is 2,340 sq. ft., of which 177 sq. ft. are in the firebox. The firebox is 10 ft. 5 ins. long and 59 ins. in diameter over the corrugations. The tender carries 6,000 gals. of water and 3,000 gals. of oil.

The simple engine has 62 in. drivers, 2,114 sq. ft. of heating surface and weighs 126,000 lbs. on driving wheels. It is a lighter engine than the compound. As a result of these tests the Southern Pacific has ordered twenty more of these compounds with Vanderbilt boilers, making twenty-five in all.

The annual report of the Pennsylvania Railroad recognizes the necessity for the extension of the company's lines into New York, and the desirability of connecting directly with the Long Island Railroad. To do this, tunnels would have to be constructed, but the depth below the surface and the gradients which the topographical conditions would render necessary seemed to make operation by steam power impracticable. Electricity as a source of power is well adapted to the conditions. The greater part of the necessary property has been secured at reasonable prices. On account of the novel engineering involved, a commission was appointed to thoroughly study the whole subject and prepare plans. Colonel Chas. W. Raymond, U. S. Army, is chairman, assisted by Mr. Gustave Lindenthal, Mr. Wm. H. Brown, chief engineer of the Pennsylvania Railroad, Mr. Chas. M. Jacobs and Mr. Alfred Noble. This commission will have general control of the undertaking. Mr. Jacobs will have direct charge of the North River section, and the East River section will be under Mr. Noble's supervision. The study of the project has progressed far enough to prove its practicability, and the commission will have the choice of several plans.




Reproduction of the Dynamometer Car Record.

## Curve Resistance Tests at West Alton, Mo., By Mr. Max Wickaorst, Engineer of Tests—Chicago, Burlington & Quincy Railway,

| Test number | 9 | 10 | 11 | 12 |
|---|---|---|---|---|
| Av. speed, miles per hr. | 8.1 | 12.9 | 18.4 | 21.9 |
| Number of cars | 19 | 19 | 19 | 19 |
| Weight of train, tons | 635 | 635 | 635 | 635 |
| Av. weight per car, tons | 33.4 | 33.4 | 33.4 | 33.4 |
| Temperature of air | 81° | 81° | 82° | 83° |

### Test 9

| Section number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| **SPEED.** | | | | | | | | |
| Initial | 8.4 | 9.1 | 6.9 | 5.9 | 6.4 | 8.4 | 8.3 | 8.0 |
| Final | 9.1 | 6.9 | 5.9 | 6.4 | 8.4 | 8.3 | 8.0 | 7.8 |
| Average | 8.8 | 8.0 | 6.4 | 6.2 | 7.4 | 8.4 | 8.2 | 7.9 |
| **DRAW-BAR PULL, POUNDS.** | | | | | | | | |
| Total, actual | 8,600 | 8,080 | 14,420 | 13,760 | 10,900 | 8,760 | 7,730 | 8,620 |
| Per ton: | | | | | | | | |
| Actual | 13.54 | 12.71 | 22.70 | 21.70 | 17.20 | 13.80 | 12.18 | 13.58 |
| Cor. for accl. | 12.75 | 17.11 | 24.54 | 21.08 | 15.20 | 13.91 | 12.50 | 13.77 |
| Cor. for accl. + grade | 3.75 | 9.90 | 17.94 | 12.48 | 3.40 | 4.91 | 3.50 | 2.37 |
| Due to curve | ..... | 12.62 | 14.35 | 17.78 | ..... | ..... | ..... | ..... |
| Per degree of curve | ..... | 1.68 | 1.91 | 2.37 | ..... | ..... | ..... | ..... |
| Av. on str. & lev. tr'k | 3.59 | | | | | | | |
| Av. per deg. of curve | 1.99 | | | | | | | |

### Test 10

| Section number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| **SPEED.** | | | | | | | | |
| Initial | 13.1 | 13.3 | 12.5 | 11.6 | 11.7 | 12.6 | 13.0 | 13.0 |
| Final | 13.3 | 12.5 | 11.6 | 11.7 | 12.6 | 13.0 | 13.0 | 11.7 |
| Average | 13.2 | 12.9 | 12.0 | 11.7 | 12.2 | 12.8 | 13.0 | 12.3 |
| **DRAW-BAR PULL, POUNDS.** | | | | | | | | |
| Total, actual | 8,450 | 8,140 | 11,920 | 13,120 | 11,100 | 8,880 | 7,610 | 7,830 |
| Per ton: | | | | | | | | |
| Actual | 13.30 | 12.81 | 18.77 | 20.66 | 17.48 | 13.98 | 11.99 | 12.33 |
| Cor. for accl. | 12.96 | 14.89 | 21.80 | 20.44 | 16.07 | 13.31 | 11.99 | 14.40 |
| Cor. for accl. + grade | 3.96 | 7.69 | 15.20 | 11.84 | 4.27 | 4.31 | 2.99 | 3.00 |
| Due to curve | ..... | 7.96 | 11.49 | 16.26 | ..... | ..... | ..... | ..... |
| Per degree of curve | ..... | 1.06 | 1.53 | 2.16 | ..... | ..... | ..... | ..... |
| Av. on str. & lev. tr'k | 3.71 | | | | | | | |
| Av. per deg. of curve | 1.58 | | | | | | | |

### Test 11

| Section number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| **SPEED.** | | | | | | | | |
| Initial | 18.8 | 19.7 | 19.1 | 18.1 | 17.4 | 17.8 | 18.4 | 18.8 |
| Final | 19.7 | 19.1 | 18.1 | 17.4 | 17.8 | 18.4 | 18.8 | 18.0 |
| Average | 19.3 | 19.4 | 18.6 | 17.7 | 17.6 | 18.1 | 18.6 | 18.4 |
| **DRAW-BAR PULL, POUNDS.** | | | | | | | | |
| Total, actual | 9,860 | 9,180 | 10,720 | 11,250 | 11,250 | 10,260 | 8,520 | 7,700 |
| Per ton: | | | | | | | | |
| Actual | 15.51 | 14.44 | 16.90 | 17.72 | 17.72 | 16.17 | 13.41 | 12.11 |
| Cor. for accl. | 13.23 | 16.81 | 21.94 | 20.38 | 16.83 | 14.77 | 12.43 | 13.98 |
| Cor. for accl. + grade | 4.23 | 9.61 | 15.34 | 11.78 | 5.03 | 5.77 | 3.43 | 2.58 |
| Due to curve | ..... | 10.80 | 11.13 | 15.14 | ..... | ..... | ..... | ..... |
| Per degree of curve | ..... | 1.44 | 1.48 | 2.02 | ..... | ..... | ..... | ..... |
| Av. on str. & lev. tr'k | 4.21 | | | | | | | |
| Av. per deg. of curve | 1.65 | | | | | | | |

### Test 12

| Section number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| **SPEED.** | | | | | | | | |
| Initial | 22.0 | 22.6 | 22.2 | 20.8 | 20.4 | 20.8 | 21.8 | 22.6 |
| Final | 22.6 | 22.2 | 20.8 | 20.4 | 20.8 | 21.8 | 22.6 | 23.1 |
| Average | 22.3 | 22.4 | 21.5 | 20.6 | 20.6 | 21.3 | 22.2 | 22.8 |
| **DRAW-BAR PULL, POUNDS.** | | | | | | | | |
| Total, actual | 9,580 | 9,300 | 10,360 | 10,350 | 10,460 | 10,360 | 10,020 | 9,320 |
| Per ton: | | | | | | | | |
| Actual | 15.09 | 14.64 | 16.33 | 16.31 | 16.49 | 16.33 | 15.80 | 14.70 |
| Cor. for accl. | 13.38 | 16.56 | 25.43 | 17.96 | 15.39 | 13.65 | 13.52 | 13.28 |
| Cor. for accl. + grade | 4.38 | 9.36 | 18.83 | 9.36 | 3.59 | 4.65 | 4.52 | 1.88 |
| Due to curve | ..... | 11.12 | 15.03 | 11.12 | ..... | ..... | ..... | ..... |
| Per degree of curve | ..... | 1.48 | 2.04 | 1.48 | ..... | ..... | ..... | ..... |
| Av. on str. & lev. tr'k | 3.80 | | | | | | | |
| Av. per deg. of curve | 1.67 | | | | | | | |

## ADDITIONAL DATA IN CURVE RESISTANCE TESTS.

| Sec. | Location of middle of train. Initial. | Final. | Elevation of middle of train. Initial. | Final. | Dif. | Lth. ft. | % gr. | Grade res. per ton. |
|---|---|---|---|---|---|---|---|---|
| 1 | 10,360.5 | 10,370.5 | 120.9 | 125.4 | 4.5 | 1,000 | .45 | 9.0 |
| 2 | 10,370.5 | 10,377.5 | 125.4 | 127.9 | 2.5 | 700 | .36 | 7.2 |
| 3 | 10,377.5 | 10,382.0 | 127.9 | 129.4 | 1.5 | 450 | .33 | 6.6 |
| 4 | 10,382.0 | 10,389.0 | 129.4 | 132.4 | 3.0 | 700 | .43 | 8.6 |
| 5 | 10,389.0 | 10,399.5 | 132.4 | 138.6 | 6.2 | 1,050 | .59 | 11.8 |
| 6 | 10,399.5 | 10,409.5 | 138.6 | 143.1 | 4.5 | 1,000 | .45 | 9.0 |
| 7 | 10,409.5 | 10,420.5 | 143.1 | 148.0 | 4.9 | 1,100 | .45 | 9.0 |
| 8 | 10,420.5 | 10,430.5 | 148.0 | 153.7 | 5.7 | 1,000 | .57 | 11.4 |

## CURVE RESISTANCE TESTS AT WEST ALTON, MO.

St. Louis, Keokuk & Northwestern R. R.

Tests Made With Dynamometer Car on 7½ Degree Curve.

By Max H. Wickhorst, Engineer of Tests of C., B. & Q. Ry.

The tests described below were made at West Alton, Mo., primarily to determine the relative résistance of a train on straight track and curves at this point. The straight track, which is tangent to the curve, has a grade of about 5 per cent. and the curve is 7½°, with about 0.33 per cent. grade. The purpose of this article is to give results of curve resistance tests which were made with our dynamometer car, and which we have reduced to pounds per ton per degree of curve. The tests were made on the 10th of September, 1901, with a train of 19 cars, including the test car and the way car, or a total tonnage of 635 tons behind the engine. The cars were mostly gondolas loaded with coal, and a list of the cars, showing scale weights, is given below:

Cars Used in Tests Numbers 9, 10, 11 and 12; in Order Beginning at the Head End.

| Number. | Initials. | Kind. | Weights—Empty. | Weights—Loaded. | Capacity. | Lading. |
|---|---|---|---|---|---|---|
| 90,151 | C., B. & Q. | Test. | 38,300 | 38,300 | ...... | ...... |
| 26,069 | L. & N. | Gond. | 24,000 | 77,800 | ...... | Coal |
| 26,445 | L. & N. | Gond. | 24,400 | 78,000 | 50,000 | Coal |
| 28,819 | L. & N. | Gond. | 23,300 | 77,900 | 50,000 | Coal |
| 27,220 | L. & N. | Gond. | 21,100 | 68,300 | 40,000 | Coal |
| 26,732 | L. & N. | Gond. | 24,100 | 78,700 | 50,000 | Coal |
| 57,372 | Southern | Gond. | 29,600 | 93,000 | 60,000 | Coal |
| 33,845 | L. & N. | Gond. | 26,200 | 94,200 | 60,000 | Coal |
| 28,586 | L. & N. | Gond. | 19,800 | 62,400 | 40,000 | Coal |
| 1,650 | L. E. & St. L. | Gond. | ...... | 71,000 | 50,000 | Coal |
| 56,537 | Southern | Gond. | 22,300 | 68,500 | 40,000 | Coal |
| 26,748 | L. & N. | Gond. | 19,800 | 66,000 | 40,000 | Coal |
| 26,567 | L. & N. | Gond. | 20,300 | 65,300 | 40,000 | Coal |
| 20,630 | C., B. & Q. | Box | 23,800 | 64,900 | 40,000 | Coal |
| 18,749 | C., B. &. Q. | Box | 24,100 | 64,700 | 40,000 | Coal |
| 13,379 | C., B. & Q. | Box | 21,600 | 52,600 | 50,000 | Coal |
| 3,107 | H. & St. Jo. | Box | 22,400 | 63,200 | 40,000 | Coal |
| 11,979 | C., B. & Q. | Box | 22,900 | 55,800 | 40,000 | D. pipe |
| 162 | StL,K&NW | Way | 30,000 | 30,000 | ...... | ...... |
| Total pounds | | | | 1,270,600 | | |
| Total tons | | | | 635.3 | | |

Most of the trucks of the gondola cars were in a condition of poor repair, and the cars were down on their side bearings. Four tests were made with this train, starting from the main line of the West Alton yards and ending at Bellfontaine bridge.

The engine was fitted with a Boyer speed recorder, this being placed in the cab, and the engineer instructed to maintain uniform speed throughout each test. The object of having speed as near uniform as possible throughout any test was to avoid the necessity of making acceleration or retardation corrections. The speeds selected were 10, 15, 20 and 25 miles per hour, respectively. In the test car we obtained a record of the drawbar pull, time and distance. As regards drawbar pull, the test car is supplied with a hydraulic dynamometer which has a piston fitted to the cylinder, without packing rings, and in calibrating the dynamometer a dead-weight gauge tester was used. The time record was obtained by means of a pen connected with an electro-magnet and clock, so as to show automatically intervals of 10 seconds. As regards distance, record was made showing when the test car passed various points, such as mile posts, beginning of curves, end of curves, etc. For the purpose of working up the records we divided each one into eight sections, as shown on the sample record given herewith. Section No. 1 represents 1/5 mile north of the beginning of the curve, that is, from the point where the train strikes section No. 1 to the beginning of the curve, representing 1/5 mile of track. Section No. 2 represents a distance equal to the length of the train from the point where it enters the curve. Section No. 3 terminates where the train starts to leave the curve again for the straight track, and this section represents the portion of track where the whole train was on the curve. Section No. 4 represents the portion of track from where the head end of train leaves the curve to a distance south equal to the length of the train. Section No. 5 represents 1/5 mile south of this. Sections 6, 7 and 8 represent 1/5 mile consecutively.

After the tests were made, levels were run over this piece of track and the average grades of the various sections are also shown on the sample diagram. These averages are for a distance one-half the train length from the beginning of the section to one-half the train length from the end of the section. In working up the results we first determined the average total drawbar pull for each section, then calculated the drawbar pull per ton, actual. This was corrected for any acceleration or retardation there may have been in the section, using the formula:

$$R_a = 91.2 \frac{V}{S}$$

where $R_a$ equals acceleration in pounds per ton, positive or negative. V equals the difference in velocity in miles per hour between beginning and end of the section. S equals seconds in going over the sections. These results then give the drawbar pull per ton for uniform speed.

Next we corrected this for grade by the formula:

$$R_g = 20\ G,$$

where $R_g$ equals grade resistance in pounds per ton, and G equals grade in per cent.

The residual then gives frictional resistances, including curve resistance, if any. To determine the normal frictional resistance with the cars under consideration, we took the average of the results obtained on straight track. For the section where the whole train was on the curve, we subtracted the normal frictional resistance from the residual obtained above, which then gives the additional resistance due to the curve. As this was a 7½° curve, we divided the results by 7½ and got the curve resistance per degree. Where the train was entering or leaving the curve, we multiplied the results obtained as before, by 2, and thus got the curve resistance per ton per degree. The results of the four tests are shown in the table herewith, which gives the initial, final and average speed for each section of each test, and also gives the drawbar pull in pounds as follows:

Total actual, per ton actual, per ton corrected for acceleration, per ton corrected for acceleration and grade, per ton due to curve, per ton per degree of curve, per ton, average on straight and level track, per ton average per degree of curve.

Results of the four tests, showing the average frictional resistance reduced to straight and level track, and also resistance per degree of curve for the four tests, are given in the following table, expressed in pounds drawbar pull per ton:

| Test No. | Friction, straight and level. | Curve resistance, per degree. |
|---|---|---|
| 9 | 3.59 | 1.99 |
| 10 | 3.71 | 1.58 |
| 11 | 4.21 | 1.65 |
| 12 | 3.80 | 1.67 |
| Average | 3.83 | 1.72 |

It will be noticed that the average resistance per ton reduced to straight and level track we found to be 3.83 lbs. for these cars under the conditions at the time. The average weight of the cars was 33.4 tons per car and an average speed of about 15 miles per hour. The curve resistance we found to be 1.72 lbs. per ton per degree of curve on this 7½° curve. Curve resistance is usually taken as equal to 0.5 to 0.7 lb. per ton per degree of curve. The results of the West Alton tests give a high figure for curve resistance. I understand the Pennsylvania road made some tests of a similar nature, which also gave a figure for curve resistance considerably higher than that usually taken. This matter is of some importance, and we hope at some time to make further tests under various conditions.

A sample diagram is given herewith showing test No. 11, which may be of interest as showing the composition of train resistance at various points respectively. It also shows the nature of the records taken in the test car. These tests were made for Mr. Henry Miller, assistant superintendent of the St. Louis, Keokuk & Northwestern Railroad, at Hannibal, Mo., and I am indebted to him for the privilege of recording these results.

(Established 1832.)

# AMERICAN ENGINEER AND RAILROAD JOURNAL.

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## EDITORIAL ANNOUNCEMENTS.

**Advertisements.**—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

**Contributions.**—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

**To Subscribers.**—*The* AMERICAN ENGINEER AND RAILROAD JOURNAL *is mailed regularly to every subscriber each month. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery, and in case the paper is not then obtained this office should be notified, so that the missing paper may be supplied.* **When a subscriber changes his address** *he ought to notify this office at once, so that the paper may be sent to the proper destination.*

Suburban service has not, as a rule, been considered sufficiently important to require special locomotives, and in most cases old and light road locomotives are used. Conditions are, however, changing, especially in large cities, where the competition of electric roads is felt and suburban service is in some cases the most difficult to manage of all passenger service. For this reason the new suburban locomotives of the New York Central seem exceedingly important. This road is not materially affected by electric road competition, but to handle heavy local trains on fast schedules out of New York City very powerful locomotives are required. This led to the design of the handsome engines illustrated in this issue. Not only are these engines heavy, they are powerful, with a heavy weight on driving wheels, large cylinder and boiler capacity, and ample grate area. Instead of a separate tender a good supply of coal and water is carried on the engine, and the disposition of it is admirable. Other roads are considering the construction of special suburban engines, and the drawings which we present will doubtless aid in the movement toward suitable locomotives for this important business. The factor most needed appears to be high accelerating power with ample boiler capacity, combined with a construction which permits of running in either direction. This design is certainly skilful, and it appears to be entirely successful. We cannot forbear the remark, however, that suburban cars are often much heavier than the actual necessities seem to demand, and the great weight of this engine suggests a study of the weight of suburban service cars.

Curve resistance has ordinarily been reckoned at about 0.5 to 0.7 lb. per ton. It has been stated to be as low as 0.43 lb., but Wellington proved fourteen years ago that it was far greater than these figures and that it depended upon the speed. In this issue are the results of recent tests on the "Burlington" by Mr. Max H. Wickhorst, engineer of tests of that road, which tend to confirm Wellington and show that under the conditions of an average speed of about 15 miles per hour the resistance on a 7.5° curve is two or three times as much as the generally accepted amount. Mr. Wickhorst finds it much greater than Wellington did at this speed. General deductions on these results should not be made, but it is safe to say that the effects of curvature are generally underestimated. Mr. Wickhorst expects to pursue this investigation further, and we hope to present his conclusions after trials on various curvatures and at various speeds in a future issue.

A great many malleable iron castings are now used in connection with rolled steel sections in car and truck construction and similar work. An important item in their design seems to have been rather generally overlooked. The malleable casting makers tell us that they could furnish castings more promptly and at a lower price in many cases if they were made with "chipping strips," which would reduce the areas of the surfaces requiring grinding for fitting against other surfaces, such as the flanges on webs of rolled steel shapes. Unless a large bearing area is required, narrow fitting strips are quite as satisfactory, and they require very much less time and labor in grinding than castings, the entire bearing surfaces of which must be ground to a fit. This becomes important in connection with an order for several thousand cars, and here is a chance for the drafting room to save quite a little expense.

Those who have used Vanderbilt boilers for oil burning have expressed very favorable opinions of their advantages with that fuel, because of their freedom from riveted seams in the region of greatest heat effect, but from the facts presented elsewhere in this issue, it appears that the conditions of combustion or of heat absorption must be better than in the case of fireboxes of the usual form. The results of the careful tests of Mr. Howard Stillman on the Southern Pacific, which, through the courtesy of Mr. H. J. Small, are published in this issue, indicate an unmistakable gain in evaporative effect. A compound locomotive would be expected to do more work, per gallon of oil, than a simple engine, but the figures show an important difference in the boiler performance as well. In "equivalent evaporation" the advantage of the Vanderbilt boiler was 9.42% in this case.

The Baldwin Locomotive Works recently celebrated the construction of their 20,000th locomotive, and the 70th year of continuous operation. It was a memorable occasion, and among the guests were many whose lives and abilities have been devoted exclusively to the development of transportation, and particularly the development of the locomotive, without which the present condition of this country would be an impossibility. We congratulate the Baldwin Locomotive Works. It is something to have built one locomotive; it is more to have built 20,000, and it is a truly great accomplishment to have built up an establishment with a capacity of 1,500 locomotives per year, and to do this with an organization, unique in its management of a force of 11,000 men. A system which erects a complete locomotive in 24 hours, and sends it out for delivery 48 hours after the boiler comes into the erecting shop, is worthy of admiration. The mantle of Matthias W. Baldwin has fallen upon the shoulders of able and skilful men.

## COMMUNICATIONS.

TREATMENT OF SPECIAL APPRENTICES IN THE SHOP.

To the Editor:

As one who has been an observer of, as well as a workman among, special apprentices in railway shops, I wish to take exception, in a measure, at least, to the remarks of "A. A. G." in your March issue. I can answer the editor's note without hesitation; the difficulty is to be overcome by the special apprentices themselves. But granting, for the sake of argument, that "A. A. G." is correct in his statement, can you blame the machinists? Here we have 50, 100 or 300 men who, from positions as messenger, blue printer, water carrier, or what not, have gradually worked up through years of service until they have become full fledged machinists. To this trade they have adhered for years, perhaps for years drawn the same wages. Along come the technical graduates, sons of directors, friends and sons of officials, and expect to receive from the machinists that which is their stock in trade, viz., the full knowledge of the machinist, in half the time, without remunerating their teachers. Is this the manner a lawyer or physician deals out instruction and advice—gratis? But the machinists are, as a rule, willing to lend a helping hand, and in a few years they see all the special apprentices advancing by steady strides to positions above them. Is it any wonder that in a few cases an old and skilled machinist should look with envy upon one of these young men as he begins his course? But, on the other hand, I believe that the skilled machinists of our railway, locomotive and car shops are liberal-minded, whole-hearted men, who are only too glad to assist the special apprentice in every possible way. But you must not expect the machinists to do it all. The special apprentice has a part to fulfill.

If the special apprentice enters a shop with the idea that he "knows it all," and that the workers, the wage earners, are beneath him, he will not see the best of the men coming up, and on bended knee proffering their services. No. We do not want workmen who will bow in submission; it is unmanly. But the special apprentice who comes to the shop with the feeling that he has years of information to acquire, and that the men in the shops are the ones who possess that information, with a very little common "horse" sense will soon come to respect and honor those men, and will find them always ready to assist and impart information.

I know of cases of special apprentices in railroad shops who were afraid of soiling their hands and clothing, who always had some different method of doing work, who always knew how to do everything, and always had an opinion to express, and they found the shop conditions just about as intolerable as "A. A. G." They would be sent to the foundry to borrow the blast furnace, or to the pattern shop for a half-round square, or taken out on a bitter cold night to hunt the "Elbertritschel." These are facts, not fancies, and the special apprentice who "pursues the even tenor of his way," minding his own business striving to attain perfection, willing to perform whatever duties are imposed upon him, and following the rules of common courtesy with his associates, is sure to meet with success.

But the special apprentice must not be treated as a "little tin god" because he has had the advantage of a college training. He must be taught from the start that he is no better than the other workmen, and that only by "keeping everlastingly at it" can he hope to be advanced. He must be treated as other workmen are treated, and no advantages given or favoritism shown, and should not be advanced over practical men unless his ability warrants the advancement.

It may be the case that in some shops too much attention is shown the special apprentices, which would doubtless bring about the results mentioned by "A. A. G."

"ENGINEER."

To the Editor:

I wish to comment upon, and answer, through my personal experience, the question asked in your editorial note upon the treatment of special apprentices in shops on page 82 of your March number.

It has been asked, "Is not the workman's ill treatment of and wrong attitude towards the special apprentices to be overcome by the apprentices themselves?" I think that an answer in the affirmative is most decidedly the only one which can be made to this question.

I am at present a student in the mechanical engineering course at Cornell University, expecting to take my M. E. degree this spring, but I have served part of my time as special apprentice during the past two summer vacation months in the shops on a large road in the Middle West.

When I first entered the shop I found there a special apprentice who was very much disliked by the workmen, and I was naturally anxious to discover the cause of his unpopularity. Unwillingness to help men, an overbearing and haughty manner, and a tendency to disagree, are not points in favor with any workman. Especially is this so in the case of a man who comes into a shop under different conditions than his fellow workman. Some of these characteristics I quickly noted in the unpopular apprentice, trying at the same time to correct them in myself, and in a gentlemanly way to become one of the men.

Although I was looked upon unfavorably at first, because of the fact that I was a special apprentice, I did not suffer any ill treatment, and in less than a month I was on the same footing in the shop as any new workman. Moreover, the fact that I was a "special" had in a large measure been lost sight of by the men with whom I had to work.

After graduation I expect to return to these shops in order that I may serve my time out, and it is with the greatest pleasure that I look forward to the renewing of acquaintances and friendships with some of the men. I will say from personal experience that the average "special" is over-impressed with his own ability, knowledge and importance when he enters a shop, and a display of this quickly places him in disfavor. I firmly believe the best thing a special can do, upon entering a shop, is to keep his mouth closed and his eyes open, and to give information only when he is asked. He will thereby win the favor and good will of the shop men. It is, therefore, upon these grounds that I assert that a special apprentice must look to himself for his treatment by the men in the shop, and not rely upon the fact that he is a special apprentice, and is a little better than his fellow workmen.

C. D. Y.

[Editor's Note.—To face and overcome opposition and prejudice is one of the most important accomplishments in the career of anyone. It is well that the special apprentice should be obliged to do this at the start, and that his way should not be unnaturally smoothed. To gain the confidence and respect of the shop is a necessity to advancement. Those who cannot do this should not continue, but try something else.]

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The Atchison, Topeka & Santa Fé Railway has been experimenting with its new tandem-compound decapods (see American Engineer, February, 1902), on the three per cent. grade up the Cajon Pass in the Sierra Nevada Mountains. The load hauled by one of these engines is reported to be 703 tons, and the length of the grade six and one-half miles. This is believed to be the heaviest load ever taken over such a grade by one engine.

---

The kindling of fires in locomotives has been reduced to a very inexpensive item on the Chicago & Northwestern Railway by the employment of strips of refuse from the manufacture of oak barrel staves. A bundle of these, of the length of an ordinary barrel stave, costs about 2½ cents and is sufficient for kindling a fire. If there is need of haste another half bundle is added. This low cost is made possible by making use of convenient material which is accessible along the line of the road.

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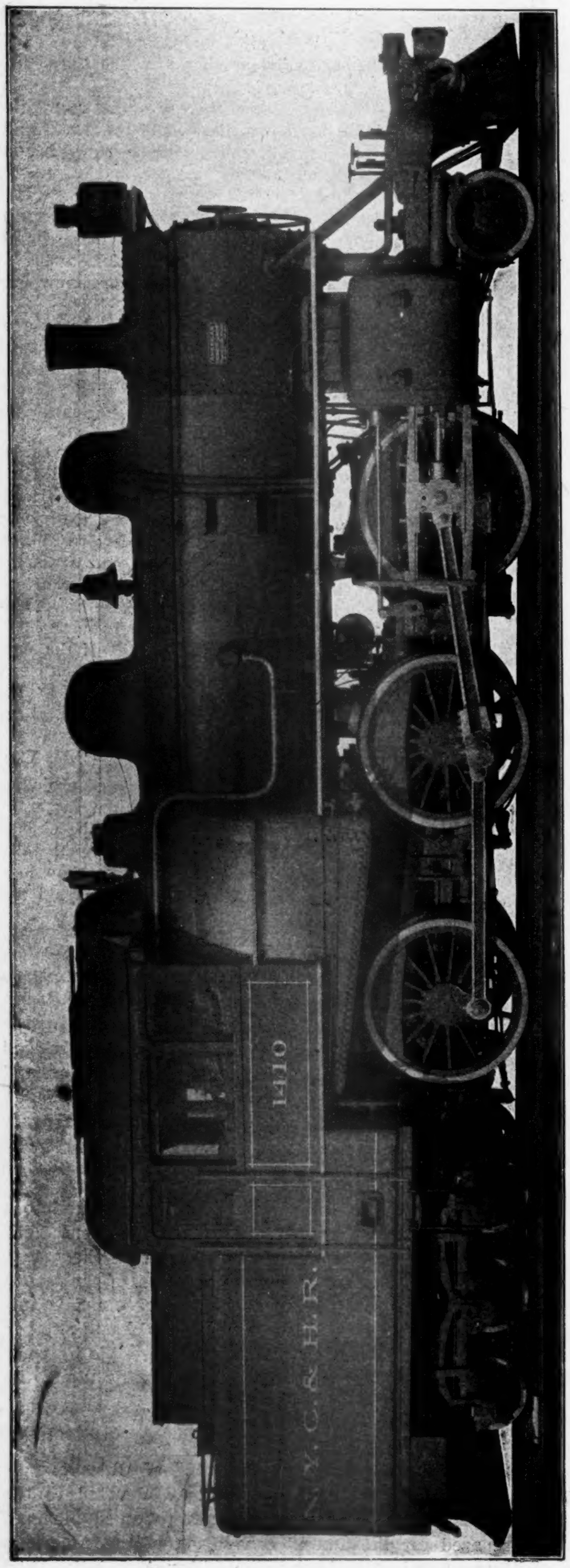
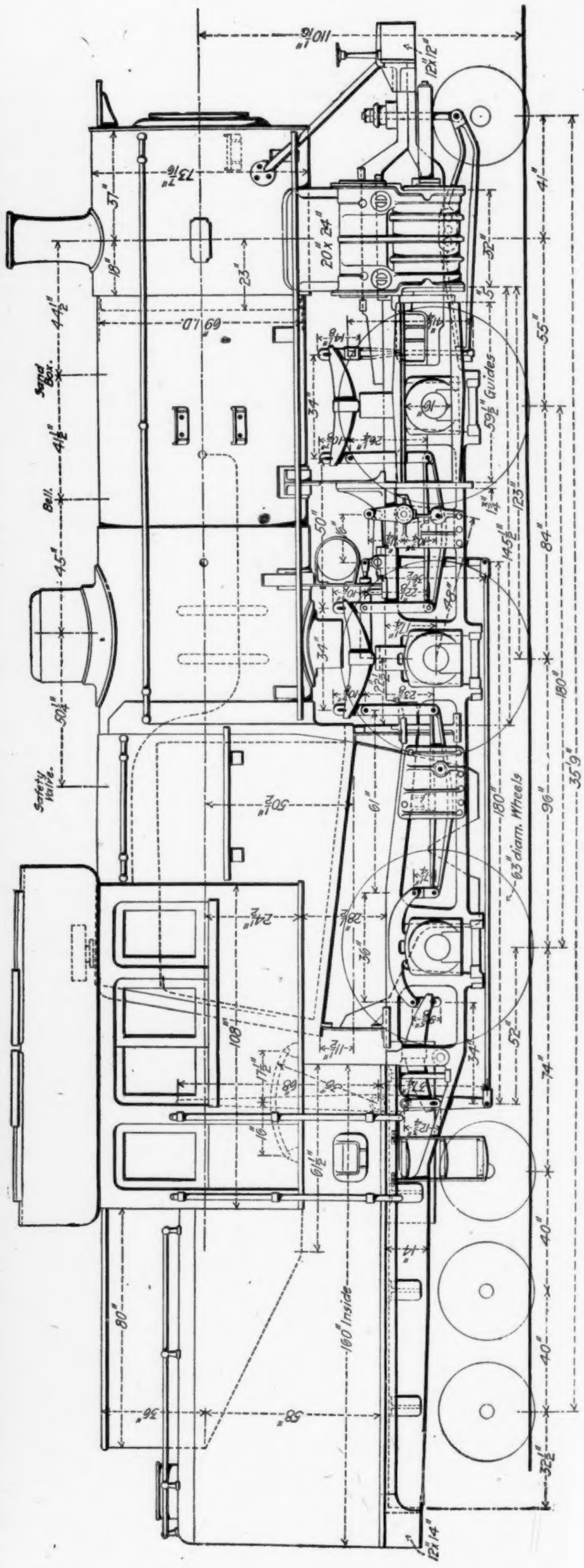
The "Railway and Engineering Review," of Chicago, published a notable special number March 15, devoted to the subject of maintenance of way, with a construction supplement. It was prepared for the annual convention of the American Railway Engineers and Maintenance of Way Association, an is the best of the special numbers of the papers prepared for that convention.

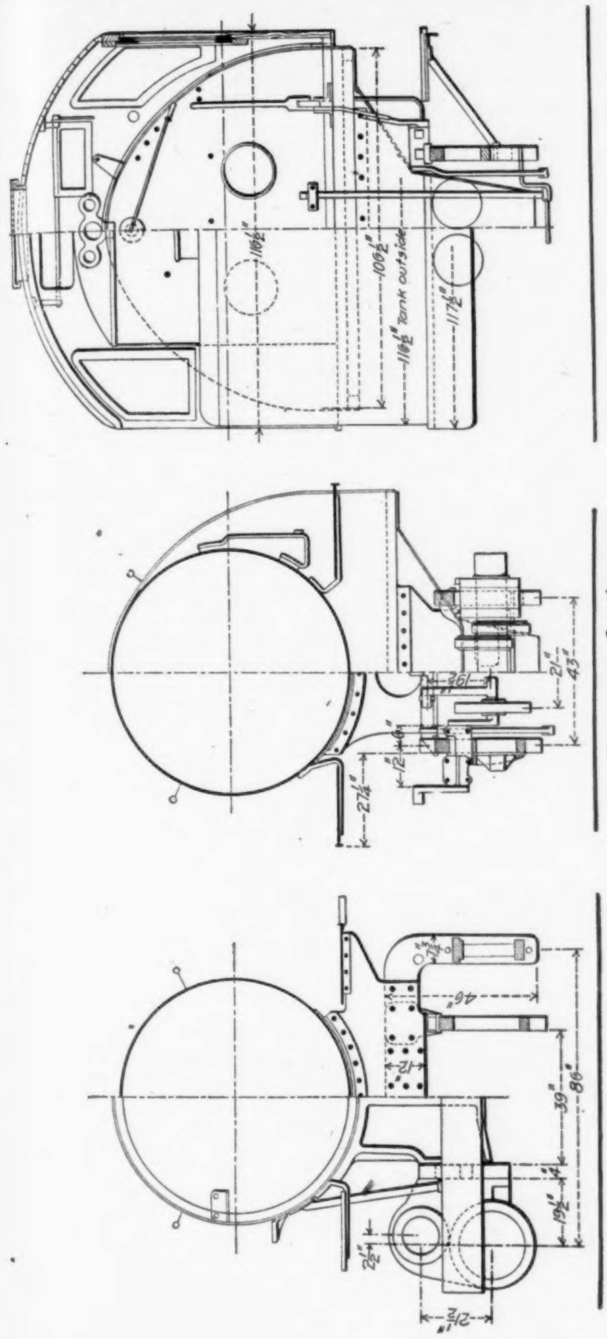


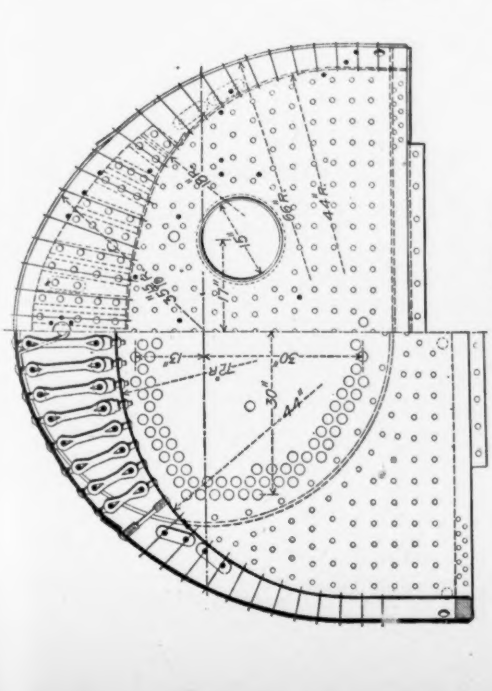

Heavy Suburban Locomotive—New York Central & Hudson River Railroad.

A. M. WAITT, *Superintendent of Motive Power and Rolling Stock.*

AMERICAN LOCOMOTIVE COMPANY, SCHENECTADY WORKS, *Builders.*




Transverse Sections.



Section Through Firebox.

## HEAVY 6-COUPLED SUBURBAN LOCOMOTIVE.

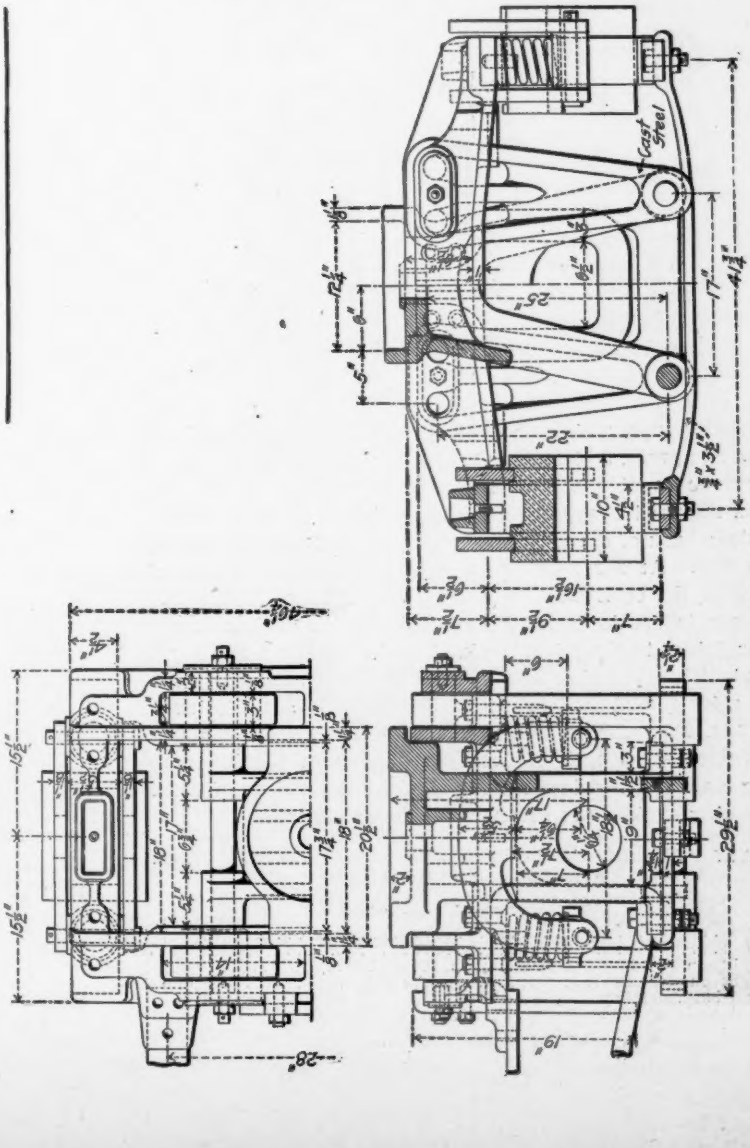
### New York Central & Hudson River Railroad.

### American Locomotive Company—Schenectady Works.

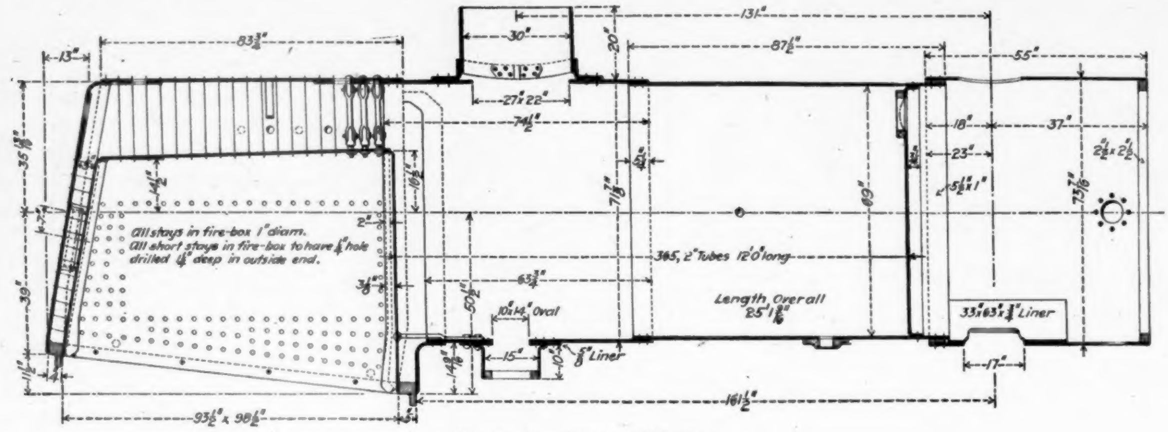
The fact that locomotives as powerful as this one are required to handle suburban trains, is impressive of the severity of present schedules. The heating surface of this engine is 2,437 sq. ft., while that of the largest 8-wheel engine on the Chicago & Northwestern is but 70 sq. ft. greater. This engine has a two-wheel leading truck, 63-in. drivers, a six-wheel truck under the tender, and 20 by 24 in. cylinders. The grate area is 62 sq. ft., and the fuel is anthracite coal.

For runs of about 75 miles large tender capacity is not required, but in the compact space 3,700 gals. of water and 5 tons of coal are carried. The engines are very powerful, and much heavier than any other suburban class ever constructed. In one section of a suburban run out of New York City, these engines cover 48.2 miles in 100 minutes, with 18 stops. On a complete run of 73 miles another train makes a speed of 25 miles per hour, with 32 stops, and including the stops. We cannot give the weights of these trains accurately, but the one first mentioned weighs about 212 tons, exclusive of the engine and the weight of the passengers. It is evident that such work requires exceptional starting power and large steam making capacity.

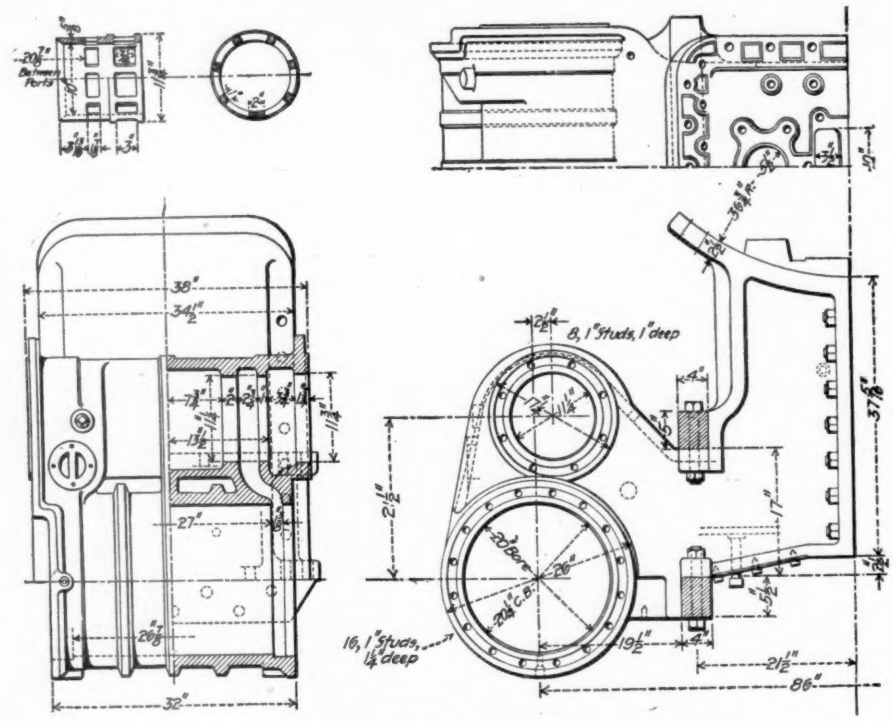
These engines have attracted a great deal of attention, and because they are unique they are illustrated in considerable detail. They are remarkably attractive in appearance, and are large engines, even among the big ones of the "Central




The Leading Truck.



Longitudinal ection of Boiler.



Cylinder and Valve Bushings.

Atlantic" type, which we have illustrated. Their accelerating power is great, and records taken from one of them show that they are capable of exerting a draw bar puu of 27,000 lbs. This required heavy frame construction with substantial fastenings back of the cylinders, which are indicated in the frame drawing. At the rear end the frames flatten out into slabs back of the cab. The frames are 40 ft. long. The equalizer system is continuous for each side of the engine from the rear driver to the pony truck. The boiler has a sloping back head. The mud ring is 5 in. wide in front and 4 in. wide on tne sides and at the back end. The grate is 7 ft. 9½ ins. long by 8 ft. 2½ in. wide, and the curve of the side sheets rapidly increases the length of the staybolts above the lower rows. There are two fire doors. The principal dimensions of these interesting engines are given in the following table:

HEAVY SUBURBAN LOCOMOTIVE, NEW YORK CENTRAL & HUDSON RIVER RAILROAD.

*General Dimensions.*

| | |
|---|---|
| Gauge | 4 ft. 8½ ins. |
| Fuel | Anthracite coal |
| Weight in working order | 216,000 lbs. |
| Weight on drivers | 128,000 lbs. |
| Wheel base, driving | 15 ft. 0 in. |
| Wheel base, rigid | 15 ft. 0 in. |

*Cylinders.*

| | |
|---|---|
| Diameter of cylinders | 20 ins. |
| Stroke of piston | 24 ins. |
| Horizontal thickness of piston | 5 x 4½ ins. |
| Diameter of piston rod | 3½ ins. |
| Kind of piston packing | Cast iron |
| Kind of piston rod packing | United States |

*Valves.*

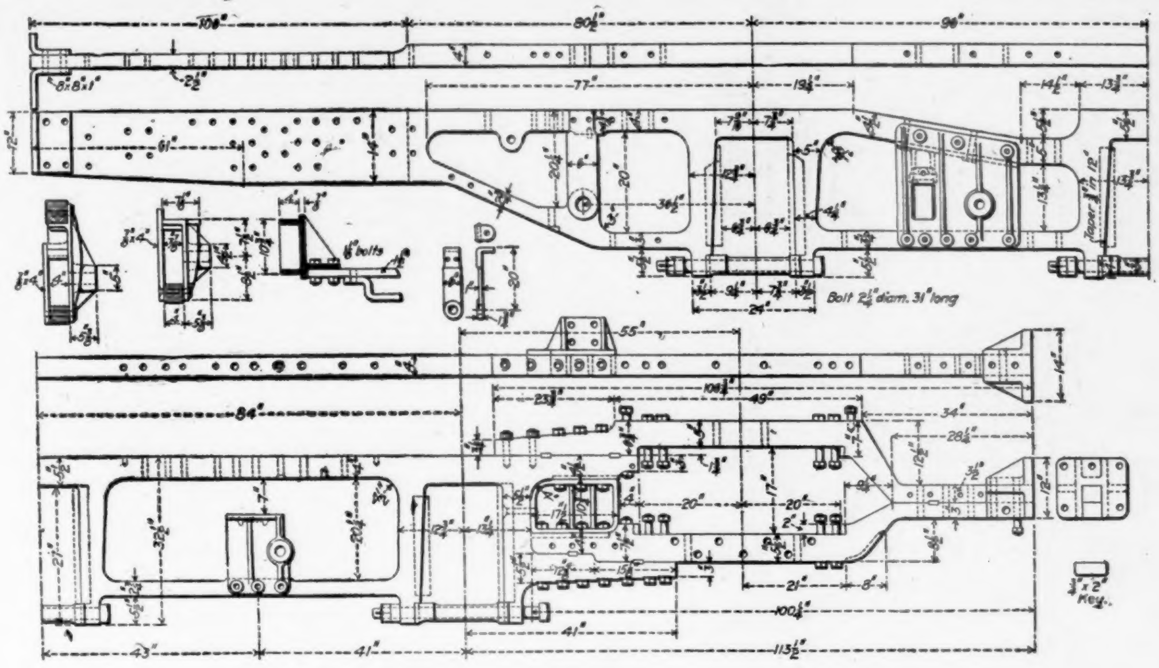
| | |
|---|---|
| Kind of slide valves | Piston type |
| Greatest travel of slide valves | 5½ ins. |
| Outside lap of slide valves | ⅞ in. |
| Inside lap of slide valves | 0 in. |
| Lead of valves in full-gear, line and line full stroke forward, | ¼ in. lead at 6 ins. cut-off. |
| Kind of valve stem packing | United States |

*Wheels, Etc.*

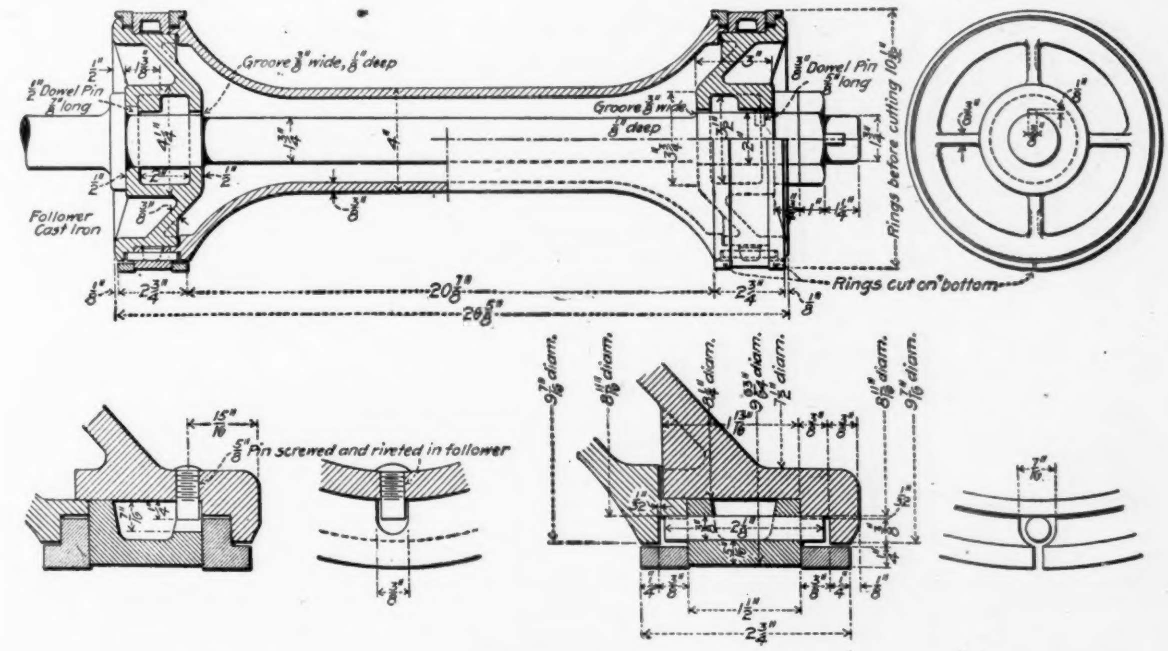
| | |
|---|---|
| Diameter of driving wheels outside of tire | 63 ins. |
| Material of driving wheel centers | Cast steel |
| Tire held by | Shrinkage and retaining rings |
| Driving box material | Cast steel |
| Diameter and length o. driving journals | 9 ins. dia. x 12 ins. |
| Diameter and length of main crank pin journals, main, 6 ins. x | 6½ ins.; main side, 7 ins. dia. x 5 ins. |
| Diameter and length of side rod crank pin journals, front, | 5 x 3⅝ ins.; back, 5 ins. dia. x 3¾ ins. |
| Engine truck, kind | 2 wheel swing bolster |
| Engine truck, journals | 6¼ ins. dia. x 10 ins. |
| Diameter of engine truck wheels | 30 ins. |
| Kind of engine truck wheels, Krupp No. 3 cast iron spoke | center, with 3⅛ in. tire. |

*Boiler.*

| | |
|---|---|
| Style | straight, with wide firebox |
| Outside diameter of first ring | 70 ins. |
| Working pressure | 200 lbs. |
| Material of barrel and outside of firebox | Coatesville steel |
| Thickness of plates in barrel and outside of firebox, ½ in., | 23-32 in., ⅝ in., ¾ in. |




Frames




Piston Valve and Packing

Horizontal seams, butt joint sextuple riveted, with welt strip inside and outside.
Circumferential seams ....................Double riveted
Firebox, length ....................93 ins.
Firebox, width ....................97⅞ ins.
Firebox, depth ....................front, 67 ins.; back, 53½ ins.
Firebox, material ....................Carbon steel
Firebox plates, thickness, sides, 5-16 in.; back, ⅜ in.; crown, ⅜ in.; tube sheet, ½ in.
Firebox, water space..front, 5 ins.; sides, 4 ins.; back, 4 ins. and 5 ins.
Firebox, crown staying ....................Radial, 1⅛ ins. dia.
Firebox, stay bolts ....................Taylor iron, 1 in. dia.
Tubes, material ....................Charcoal iron
Tubes, number of ....................365
Tubes, diameter ....................2 ins.
Tubes, length over tube sheets ....................12 ft. 0 in.
Heating surface, tubes ....................2,2,5 sq. ft.
Heating surface, firebox ....................162,000 sq. ft.
Heating surface, total ....................2,437 sq ft.
Grate surface ....................62.07 sq. ft.
Grate, style ....................Rocking, cast iron grate
Ash pan, style ....................Hopper, dampers front and back
Exhaust pipes ....................Single
Exhaust nozzles ....................5 ins., 5¼ ins., 5½ ins., dia.
Smoke stack, inside diameter ....................14 ins.
Smoke stack, top above rail ....................14 ft. 8 ins.
Boiler supplied by 2 monitor injectors, screw handled R. & L. inside of cab

*Tank and back end of engine.*

Wheels, number of ....................6
Wheels, diameter ....................30 ins.
Journals, diameter and length ....................5 ins. dia. x 9 ins.
Rear truck, one 6-wheel center bearing, swing motion, with wrought iron side bars and iron cross beams.
Water capacity ....................3,700 United States gallons
Coal capacity ....................5 tons
Total wheel base of engine and tender ....................35 ft. 9 ins.

The engine has the following special equipment: Three consolidated muffled safety valves; Westinghouse-American combined brakes; Westinghouse 9½ in. air pump and Westinghouse air signal; Leach D-2 double sand feed; Gould couplers; Star 6-in. chime whistle and Sansom bell ringer.

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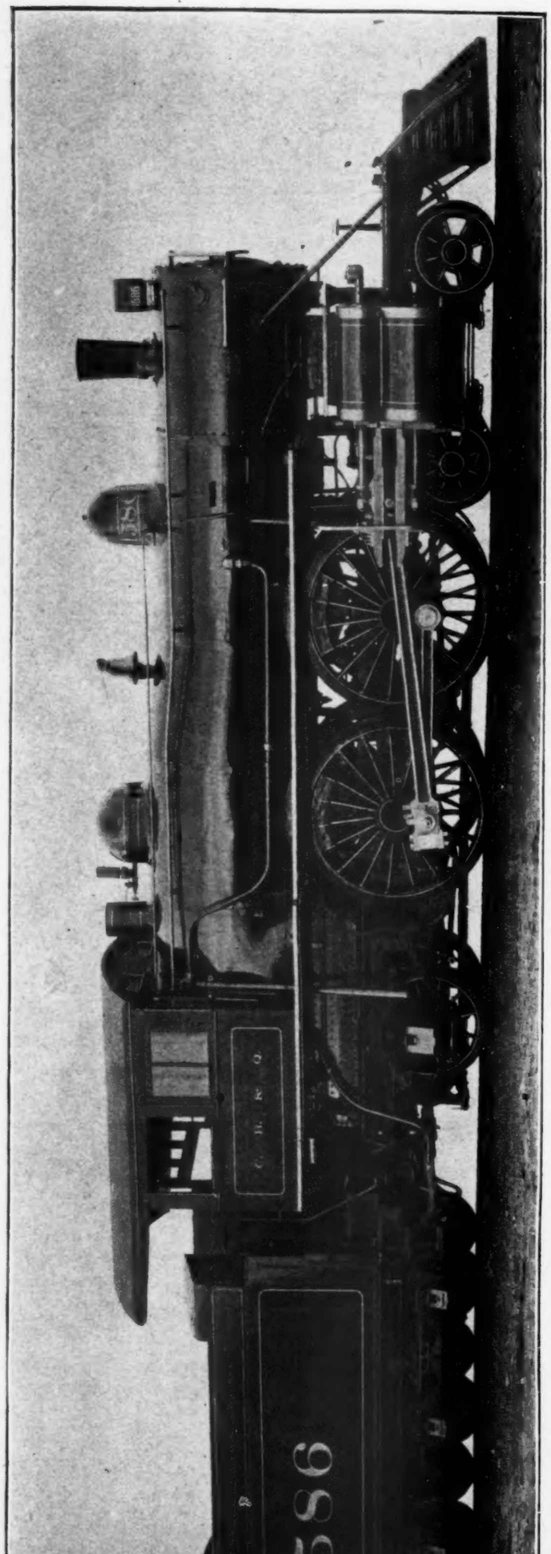
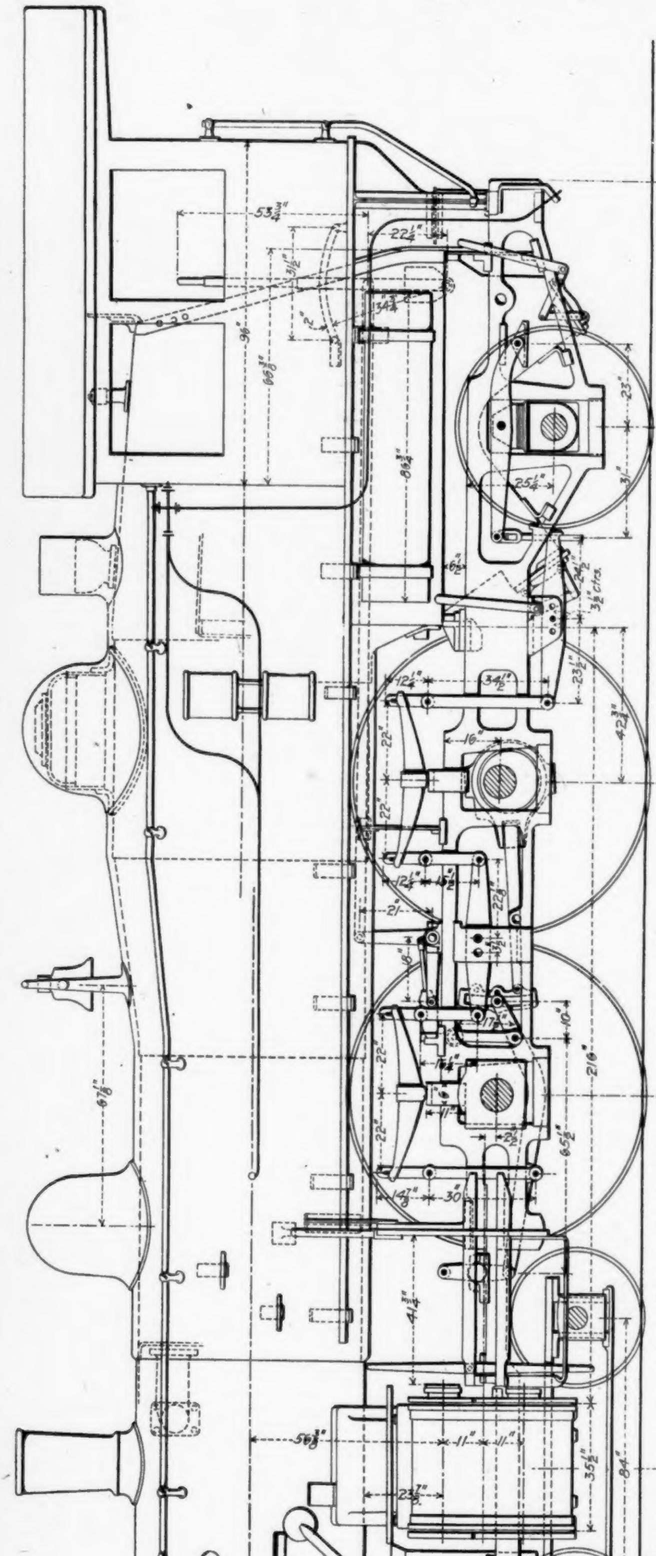
The American Brake Shoe and Foundry Company, with temporary offices at 26 Cortlandt street, New York, has assumed control of the following types of brake shoes: Sargent skeleton steel, the "Diamond S," the skeleton steel insert, the Lappin, Streeter, Corning and Ross-Mehan. Until further notice orders should be sent direct to the several combines.





**Vauclain Compound Atlantic Type Passenger Locomotive, Chicago, Burlington & Quincy Railway.**

F. H. CLARK, *Superintendent Motive Power.* BALDWIN LOCOMOTIVE WORKS, *Builders.*

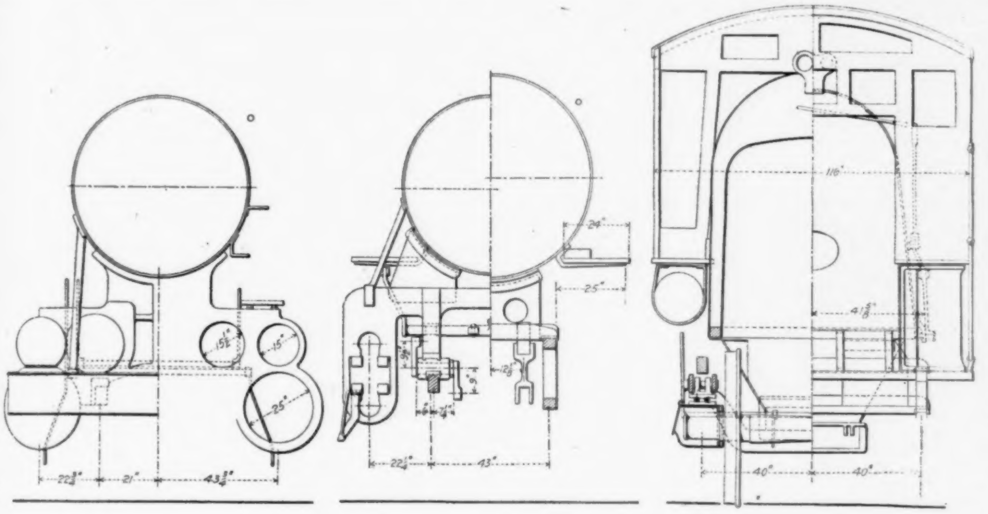
## COMPOUND ATLANTIC TYPE PASSENGER LOCOMOTIVE.

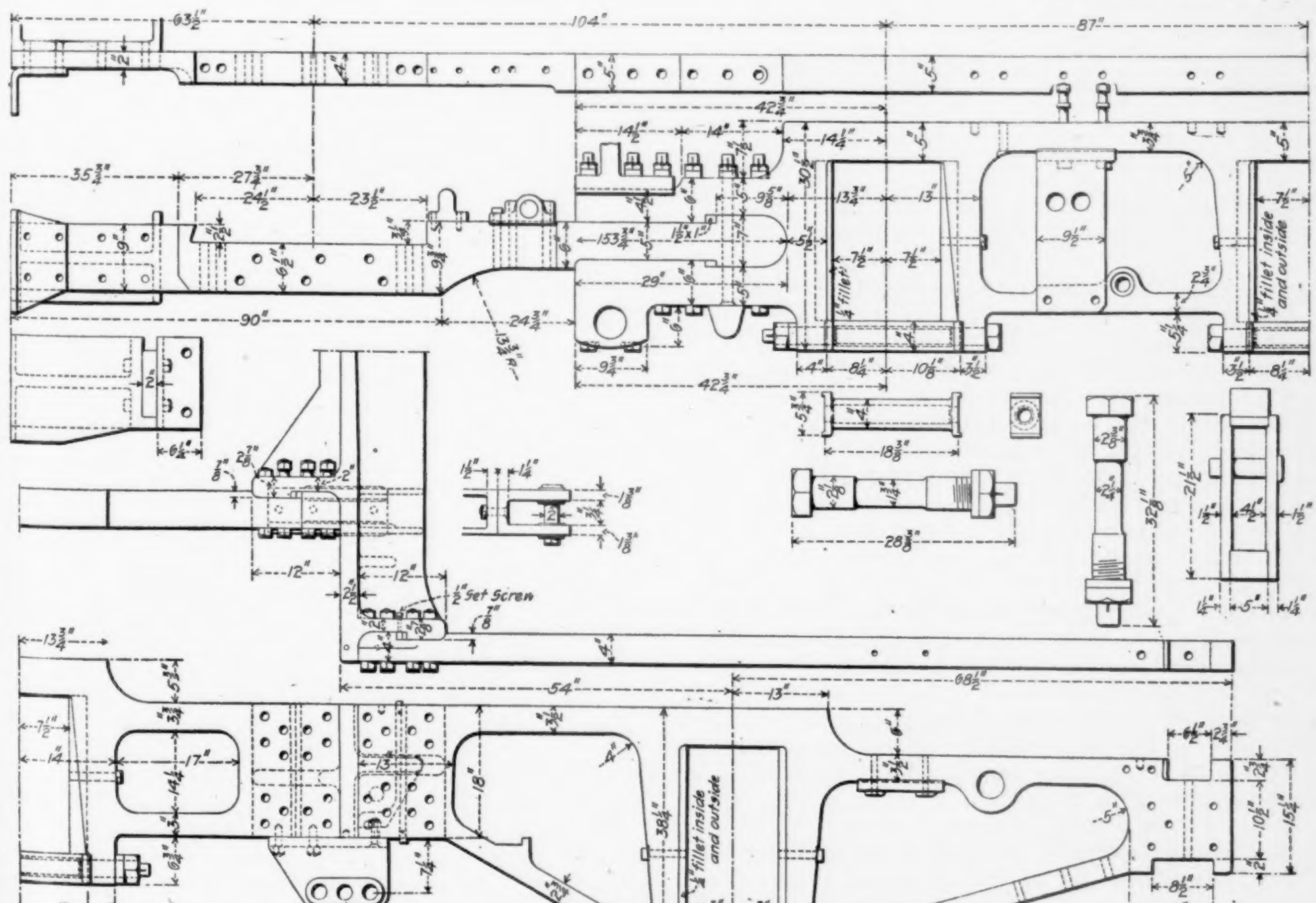
Chicago, Burlington & Quincy Railway.

For heavy passenger service the Chicago, Burlington & Quincy has received from the Baldwin Locomotive Works the first of a number of heavy, Atlantic type, Vauclain compounds with wide fireboxes, which are specially interesting because of the considerable increase of capacity above the design of the same type, with narrow fireboxes, by the same builders, which was illustrated on page 141 of our May number of 1899. The advance of three years is represented by the following table:

| | 1899. | 1902. |
|---|---|---|
| Cylinder | 13½ and 23 by 26 in. | 15 and 25 by 26 in. |
| Heating surface | 2,510 sq. ft. | 2,990 sq. ft. |
| Grate area | 33.6 sq. ft. | 44.25 sq. ft. |
| Weight on drivers | 85,850 lbs. | 95,880 lbs. |
| Total weight | 159,050 lbs. | 183,080 lbs. |

Besides having a wide firebox the present design has outside journals for the trailing wheels, and the trailing truck, which was developed by Mr. F. A. Delano for the first Prairie type engine (American Engineer, April, 1900, page 104), with modifications in the equalizer attachments. The trailer truck boxes have roller bearings, to take care of the side motion. This construction at the rear end necessitates an offset in the rear portions of the frames, which is illustrated in the frame drawing. A large steel casting is employed at the frame splice, an arrangement which seems to have given excellent service on this road. The grate area is not so large as to require a large angle of slope for the firebox sides; in fact, these are nearly vertical. The driving journals are 9½ by 12 ins.





**Vauclain Compound Atlantic Type Passenger Locomotive.**
**CHICAGO, BURLINGTON & QUINCY RAILWAY.**

The tractive power of these engines is 20,000 lbs. when operating compound, and 22,000 with live steam in the low pressure cylinders. They are equivalent to simple engines with 19-in. cylinders as compounds, and when starting can exert tractive power equivalent to 20-in. cylinders.

For comparison with other Atlantic type engines the following references to descriptions of this type may be consulted: American Engineer, October, 1900, page 304; February, 1901, page 37, and January, 1902, page 15. The chief dimensions of the design are given in the following table:

ATLANTIC TYPE COMPOUNDS, CHICAGO, BURLINGTON & QUINCY RAILWAY.

| | |
|---|---|
| Gauge | 4 ft. 8½ ins. |
| Cylinder | 15 and 25 by 26 ins. |
| Valve | Balanced piston |
| Boiler, type | Wagon top |
| Boiler, diameter | 64 ins. |
| Boiler, thickness of sheets | 11-16 in. and ¾ in. |
| Boiler, working pressure | 210 lbs. |
| Boiler, fuel | Soft coal |
| Boiler, staying | Radial |
| Firebox, material | Steel |
| Firebox | length, 96⅛ ins.; width, 66⅛ ins. |
| Firebox, depth | front, 70⅝ ins.; back, 68⅝ ins. |
| Firebox, thickness of sheets, sides, 7-16 in.; back, ⅜ in.; crown, | ⅜ in.; tube, ½ in. |
| Firebox, water space | front, 4; sides, 4; back, 3 |
| Tubes, material | Iron, wire gauge No. 11. |
| Tubes, number | 330; diameter, 2; length, 16 ft. 6 ins. |
| Heating surface, firebox | 155.5 sq. ft. |
| Heating surface, tubes | 2,834.5 sq. ft. |
| Heating surface, total | 2,990 sq. ft. |
| Heating surface, grate area | 44.25 sq. ft. |
| Driving wheels, diameter outside | 84¼ ins. |
| Driving wheels, diameter of center | 78 ins. |
| Driving wheels, journals | 9½ by 12 ins. |
| Engine truck wheels (front) diameter | 37¼ in. |
| Engine truck, journals | 6 x 10 ins. |
| Trailing wheels, diameter | 54¼ ins. |
| Trailing wheels, journals | 8 x 12 ins. |
| Wheel base, driving | 7 ft. 3 ins. |
| Wheel base, rigid | 7 ft. 3 ins. |
| Wheel base, total engine | 27 ft. 8 ins. |
| Wheel base, total engine and tender | about 56 ft. |
| Weight, on driving wheels | 95,880 lbs. |
| On truck | 47,000 lbs. |
| On trailing wheels | 40,200 lbs. |
| Total engine | 183,080 lbs. |
| Tank, capacity | 6,000 gal. |
| Tender, wheels | number, 8; diameter 37¼ ins. |
| Journals | 5 x 9 ins. |
| Service | passenger |

## SIDE MOTION IN COUPLERS AND LATERAL MOTION IN TRUCKS.

In considering the necessities of the draft gear situation, increased capacity to care for the increasing severity of service is probably fully appreciated. Many well-directed efforts are being made to meet this requirement, and good, sound progress is the result. Capacity to receive heavy shocks in pulling and buffing is, however, not sufficient. These shocks, important as they are, by no means cover the whole punishment of draft gear. Much of the destruction due to rough handling of cars in yards will be overcome by stronger gear, but there is a direction in which draft gear may be too strong, that is, to say, too rigid. The necessity for sufficient side play of the coupler shanks for taking curves is unquestionably generally overlooked, especially by those who have discarded swing motion trucks, or their equivalent. An article in another column directs attention to this, and in addition to Mr. Smart's discussion it should be emphatically stated that if a tender is backed up to a 70-ft. car on a 19° curve the two couplers will not approach each other within about 6 ins. If the couplers in this case are coupled up this 6 ins. must be absorbed somewhere at the expense of severe strains if not "accident." It has been ascertained in a rough experiment that side stresses amounting to 57,000 lbs. may be set up in this way on passenger equipment. Of course, the length of cars has an important influence on these stresses, but even in relatively short freight cars they are undoubtedly sufficient to explain some of the destruction which is now going on and which may, for lack of means of knowing its amount, be wrongfully charged to rough handling. An important discussion of this question will be found in the Proceedings of the Western Railway Club for October, 1901. Whatever may be done with the coupler and draft gear to provide for or reduce these lateral stresses, it seems reasonable to believe that the equivalent of the side motion truck will afford greatly needed relief in this direction.

## THE VALUE OF UP-TO-DATE TOOLS FOR RAILROAD WORK.

By M. K. Barnum, Master Mechanic, Union Pacific R. R.

A paper read before the Western Railroad Club.

The amount of money that is wasted every day by the lack of "up-to-date" tools is appreciated by very few railroad officials. Even many superintendents of machinery and master mechanics do not fully realize the saving that can be effected by replacing worn out and obsolete machines with others which are strictly "up-to-date" and fitted with all the latest improvements.

If an old machine can be replaced with a new one which will do enough more work or do the same work with enough less labor to represent a saving in money equal to 5 per cent. per annum on the investment it should be entitled to careful consideration, as this is the basis on which other railroad improvements are figured. How easy then, ought it to be for mechanical men to obtain approval on a requisition for a machine which will save from 10 per cent. to over 100 per cent. per annum on the investment.

A few actual examples of such savings may be needed to convince those who have not studied this question, or others who have not had the new machines to compare with old ones.

(1) In a railroad shop employing about 160 machinists there were no horizontal boring machines for such work as boring driving box brasses, rod brasses, rocker boxes, air pump cylinders, etc., and all such work had to be done in lathes, milling machines or drill presses.

After repeated conferences and much argument, accompanied by estimates of savings that would result, permission was obtained to order a No. 2½ horizontal boring and drilling machine with 4 in. bar and latest attachments. It has been in use about 18 months and shows earnings by money saved as follows:

| | |
|---|---|
| Original cost of machine installed ready for work | $1,696.00 |
| Average savings per year as compared with old manner of doing same work | 900.00 |
| Interest on investment | 53 per cent. |

It formerly required three hours to bore a driving box brass for a 9 x 12 in. journal in a milling machine and about four hours to do the same work with a lathe, whereas they are now bored in one hour in the horizontal boring machine. Rocker boxes ,tumbling-shaft boxes, etc., are done in one-half the time formerly used.

In boring air pump cylinders it was formerly necessary to take the pump apart and set and bore each cylinder separately, requiring from two to three hours each. In the new machine it is possible to bore all four cylinders of a New York pump at one setting, without taking them apart, and requires but an average of one hour for each cylinder. In addition to the saving in time, much greater accuracy is insured. It is very conservative to say that this machine does double the work of the old ones, thereby saving the wages of one machinist at $3.00 per day for 300 working days, or $900.00 per year.

(2) An old car wheel borer was replaced by a new, heavy 42-in. borer with hub-facing attachment, power crane for handling wheels, etc., which cost, installed, $1,710.90. This wheel borer saves the wages of one helper three hours a day and does more than double the work of the old machine, making a total of $2.45 per day, or $735.00 a year, which amounts to 42½ per cent. on the investment.

(3) A new heavy double head car-axle lathe, costing

$1,665.00 installed, turns out one-third more work than the old one on account of taking a heavier cut and heavier feed, thereby saving about $250.00 a year, or 15 per cent. on the principal.

A long list of such examples could be given to show the increased earning power of machine tools which are strictly up-to-date. Tools are not up-to-date when there is something else on the market which will do more work or do it at less cost of labor. They need not necessarily be worn out to be wasteful by comparison.

Most engine lathes of modern design have greater power, weight and strength to withstand heavier cuts and coarser feeds than those built 20 or 25 years ago, which enables the former to turn out from 20 to 30 per cent. more work. This represents savings equal to from 15 to 35 per cent. interest on the investment, varying with the cost of the lathe and the class of the work for which it is used.

Recent planers are built 30 to 50 per cent. heavier than they were 20 years ago, with greater power and quicker return, the latter running as high as 72 to 80 feet per minute as compared with 40 ft. or less for the older machines. They are also fitted with three or four tool heads, whereas the old planers had only one or two at most. This means an increase of 25 to 50 per cent. in the amount of work done, or earnings of 10 to 25 per cent. on the amount expended for the machine.

The various types of turret lathes for making bolts, studs and pins from bar iron are well adapted to locomotive work and will easily turn out twice or three times as much of this class of work as will an ordinary old style engine lathe. Such machines cost $1,600.00 to $1,800.00, and make a return of from 50 to 60 per cent. in savings. Tho large automatic turret lathes for turning piston heads, cylinder packing, bull rings, balanced valve rings, etc., will do double the amount of this work that an engine lathe will, and the same may be said of the latest boring and turning mills.

Many improvements have been made in drill presses, among which may be mentioned easier and quicker adjustments of both spindle and work, swiveling tables, tapping attachments, multiple spindle drills, variable speed countershafts, etc., all of which help to increase the output.

Milling machines are great time savers on certain classes of work which used to be done on slotters, shapers or planers, and are especially economical where a large number of duplicate parts are to be made. Every tool room ought to have at least one universal milling machine, and there are various jobs of locomotive work that can be done to great advantage on such machines. The percentage of saving to be obtained depends not only on the original cost and amount of additional work done, but also on the rate of pay and skill of the operator and the number of hours the machine is run. As a rule, improved small tools will therefore earn a larger rate of interest on the investment than larger and more expensive ones.

There are very few railroads to-day which have not more or less pneumatic drills, hammers, riveters, hoists, etc., and no argument should be necessary to demonstrate their earning capacity, but the value of air jacks for cars and locomotives is not so generally known. It formerly required about four hours for eight men with screw jacks to take a 10-wheel engine weighing 132,000 pounds off its drivers, at a cost of $5.14, and about one-half that time for four men to do the same work with hydraulic jacks, but using four pneumatic jacks, it is now regularly done by four men in one hour at a cost of 66 cents. However, to be strictly up-to-date an electric crane should be used and the time reduced to ten minutes.

A pneumatic ram was recently made at a cost of $168.55 for breaking staybolts to remove worn out fireboxes, which earns very large interest on the investment. It formerly cost $45.60 to cut out the crown bolts and staybolts of a 10-wheel locomotive with 9-ft. firebox, using three men, but with the pneumatic ram it is done by two men for $15.20, thereby saving $30.40 on each firebox. If only one firebox was removed each year this tool would earn 10 per cent. on the investment, but as this shop applies 30 new fireboxes a year the saving amounts to $912.00, or 541 per cent. per annum on the amount invested.

The improvements and radical departures during the past ten or fifteen years, from old practice in the manufacture of machine tools for metal working, have been much greater than in wood working machinery; but recent designs of planers, tenoners, moulding and mortising machines are much heavier and more powerful and will do from 25 to 50 per cent. more work than old machines.

The hollow chisel mortiser is an ingenious and very profitable tool for any shop, and the four and six spindle boring machines are great labor savers. Wood trimmers are most valuable additions to the equipment of cabinet or pattern shops, and the new pattern and corebox machines will easily earn 100 per cent. on their cost if used one hour a day.

In figuring the earnings of the "up-to-date" tools in the above example, only average results have been taken and not special cases of unusual savings. No credit has been allowed for the scrap value of old machinery thrown out, nor have we considered the saving in shop room due to the use of more efficient tools; and last, but not of least importance in railroad work, is the reduction in the number of days locomotives must be held out of service for repairs, which will follow the use of up-to-date machinery.

In a certain shop which makes general repairs to about 160 locomotives a year the average length of time required to put each engine through the shop was reduced from 34 days in 1898 to 30 days in 1900. This represents a saving of 640 days for one locomotive, which, at a rental value of $10.00 a day, gives $6,400.00. As this was done with the addition of only a few new machines in a shop full of old and worn out tools, many of which had been in service from 25 to 35 years, you can readily understand how much greater saving could be effected had the shop been fully equipped with up-to-date machinery.

## THE METRIC SYSTEM—A PROTEST.

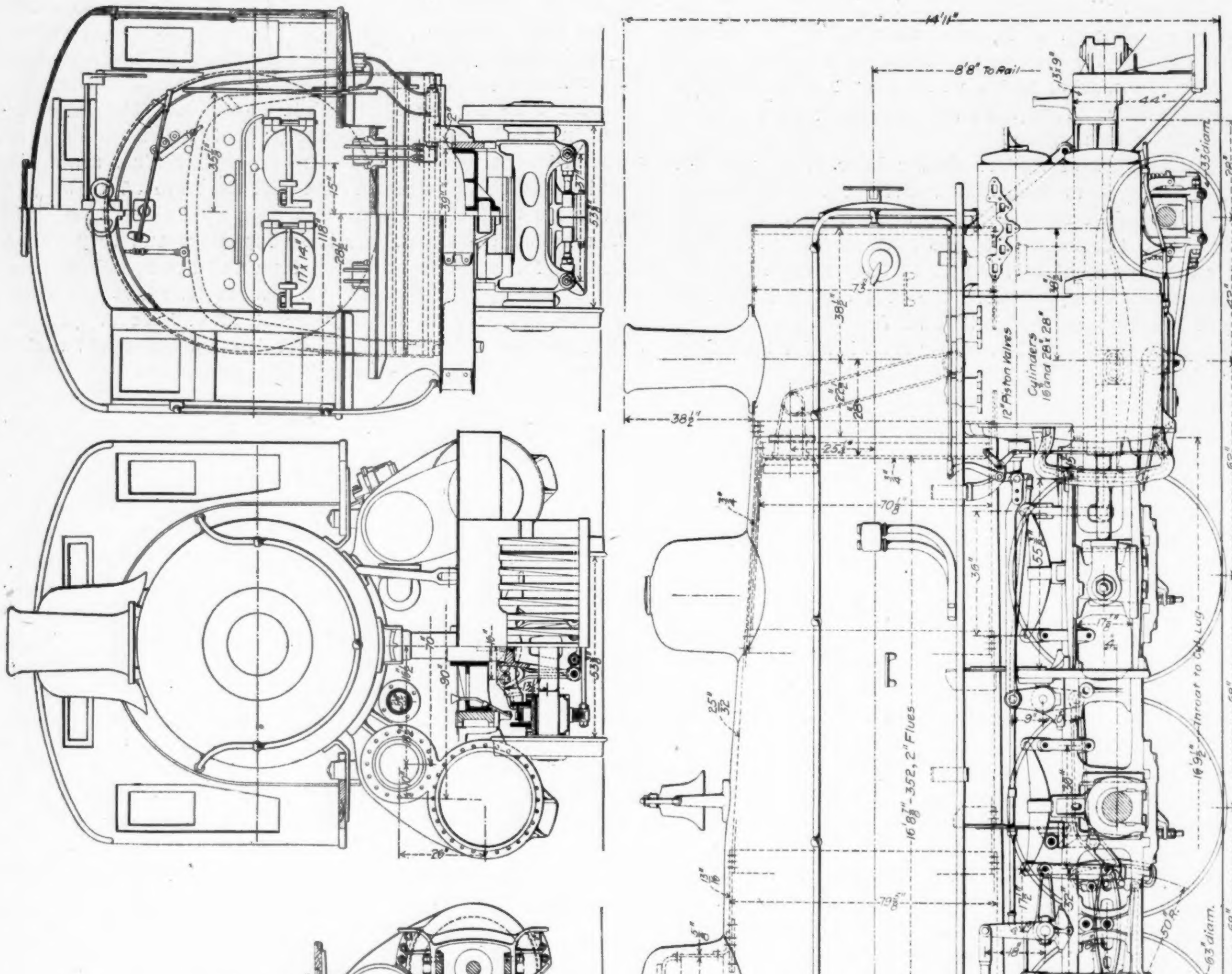
The executive committee of the American Society of Mechanical Engineers has issued, in the form of a circular letter to all members, the report of its committee on the metric system. The report is signed by Messrs. Coleman Sellers, Coleman Sellers, Jr., George M. Bond, J. E. Sweet and Charles T. Porter, and is strongly against the compulsory adoption of the metric system in this country. Members are earnestly urged to address their respective representatives in Congress and to protest against the pending legislation in that direction. It is pointed out that the metric or French system is now legal, and its use is optional, while, if the bill now before the House is passed it will be illegal to use in the United States pounds and tons, yards, feet and inches, and gallons, as measures.

## EXPERIMENTS ON SPIRAL SPRINGS.

### Typographical Error.

On page 85 of our March number a typographical error occurred which we regret exceedingly. In the paper by Messrs. Benjamin and French, near the middle of the second column on that page the formulæ should read:

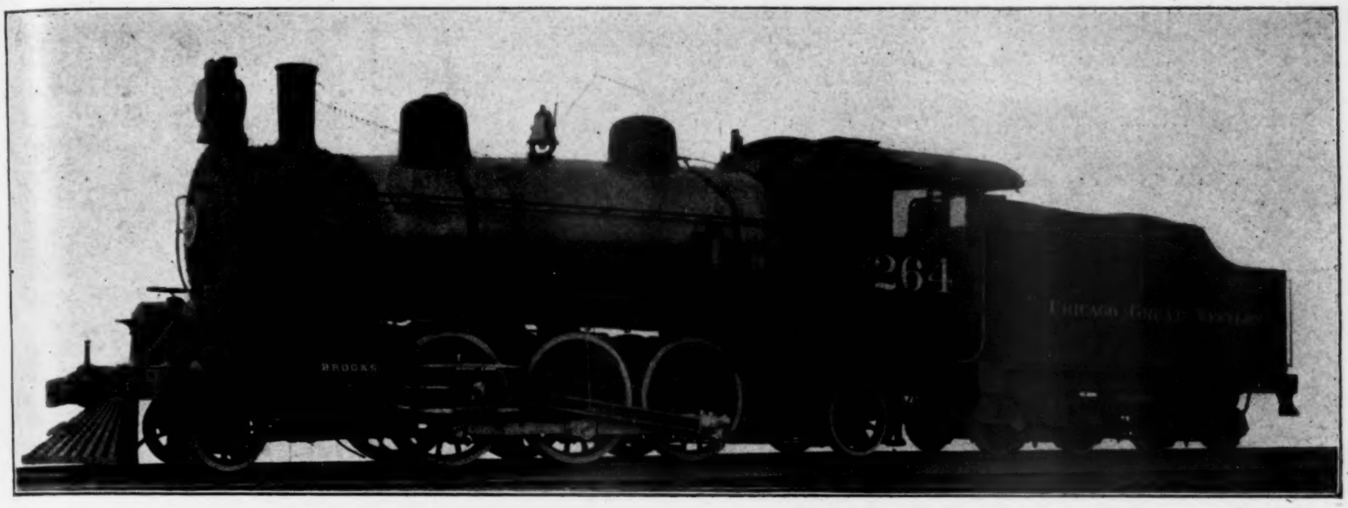
$$P = \frac{Sd^3}{2.55D} \text{ and } x = \frac{LDS}{Gd}$$




"Lake Shore" Type Tandem Compound Freight Locomotive—Chicago Great Western Railway.

MR. D. VAN ALSTINE, *Superintendent Motive Power.*

AMERICAN LOCOMOTIVE COMPANY, BROOKS WORKS, *Builders.*




**" Lake Shore " Type Tandem Compound Freight Locomotive—Chicago Great Western Railway.**

## "LAKE SHORE" TYPE TANDEM COMPOUND LOCOMOTIVE.

Chicago Great Western Railway.

For Freight Service.

These engines, built at the Brooks works of the American Locomotive Company, are very heavy examples of the "Lake Shore" or "Prairie" type, and are particularly interesting because of the use of tandem compound cylinders with a novel arrangement of the support of the guides, whereby the packing of the low pressure pistons may be reached quickly and conveniently. With the exception of the 10-wheel compounds built in 1900 for the Lehigh Valley, these engines are the heaviest of the six coupled type that we have in our record. They are heavier by 1,700 lbs. than the new Sante Fe prairie type engines (American Engineer, December, 1901, page 373), and the fact that they are tandem compounds, from the Brooks Works, renders them specially worthy of interest. These works had early experience with this type of compound, and have embodied their experience in this design.

Unlike the Lake Shore and Santa Fe engines, the main wheels of this design are the third pair, which gives a long main rod. With 63-in. drivers the wheel base is 29 ft. 2 ins. and the length of tubes but 16 ft. 9 ins. Thus the difficulties in connection with this type are greatly reduced by the size of the driving wheels. The center of the boiler is 8 ft. 8 ins. above the rail. As these engines are to be used in bad water districts the boiler design was considered with special care, the boiler being constructed in accordance with the views and experience of Mr. Van Alstine, who prefers good circulation and large water spaces to the maximum possible amount of heating surface. For this reason the tubes, which are 2 ins. in diameter, are spaced at 2 29-32-in. pitch. Four-in. water spaces are provided at the mud ring, which is of cast steel, and from a height of 12 ins. above the mud ring the length of the stay bolts increases to a length of 7 ins. at the crown. In making the mud ring of cast steel advantage was taken of the opportunity of using deep lugs at the ends for attaching the plates to support the back end of the boiler. These works are now making mud rings with cast steel ends welded to wrought sides.

Cast steel motion bars connect the links with the rockers, the attachments being made with forks with long bearings to give direct stresses. The links and rockers are of cast steel, and also the brake hanger brackets. The guide yokes have large cast steel brackets, similar to those of the Lake Shore engines. The leading truck has long three point hangers and coil springs with curved yokes, the trailing trucks being Player's patent, of the radial type.

In the side elevation and sectional views through the guides the ingenious curved steel castings for supporting the front ends of the guides may be seen. These arms carry the guides clear of attachment to the rear cylinder heads and permit of pulling these heads and the low pressure pistons back far enough to reach the packing rings with no difficulty. This is a bold construction, which is worked out in an attractive manner. If it does not develop structural weakness it offers the simplest and most convenient method of dealing with the chief difficulty in the tandem arrangement of cylinders. For packing the piston rods between the cylinders reversed vibrating cups are used. Enlarged wheel fits for crank pins and axles are a feature of this design. The main driving journals are 9½ by 12 ins., and the others 9 by 12 ins. In the spring rigging several adjustable ball spring hangers are used. These will be convenient in adjusting the spring rigging.

Twenty of these fine engines are now being built, with a larger number in prospect. Further references to the cylinders and other special features of these engines will be made in a future issue. The following table gives the chief dimensions:

"LAKE SHORE" TYPE TANDEM COMPOUND FREIGHT LOCOMOTIVE, CHICAGO GREAT WESTERN RAILWAY.

| | |
|---|---|
| Gauge | 4 ft. 8½ ins. |
| Kind of fuel to be used | Illinois and Iowa bituminous coal |
| Weight on leading wheels | 28,400 lbs. |
| Weight on driving wheels | 133,200 lbs. |
| Weight on trailing wheels | 30,100 lbs. |
| Weight on total | 191,700 lbs. |
| Weight on tender loaded | 120,000 lbs. |

*General Dimensions.*

| | |
|---|---|
| Wheel base, total of engine | 29 ft. 2 ins. |
| Wheel base, driving | 11 ft. 4 ins. |
| Wheel base, total engine and tender | 54 ft. 2¼ ins. |
| Length over all, engine | 40 ft. 11 ins. |
| Length over all, total engine and tender | 64 ft. 9 ins. |
| Height, center of boiler above rail | 8 ft. 8 ins. |
| Height of stack above rail | 14 ft. 11 ins. |
| Heating surface, firebox | 179 sq. ft. |
| Heating surface, tubes | 3,071 sq. ft. |
| Heating surface, total | 3,250 sq. ft. |
| Grate, area | 48.5 sq. ft. |

*Wheels and Journals.*

| | |
|---|---|
| Wheels, leading, number | 4 |
| Wheels, leading, diameter | 36 ins. |
| Wheels, driving, number | 6 |
| Wheels, driving, diameter | 63 ins. |
| Wheels, trailing, number | 2 |
| Wheels, trailing, diameter | 42 ins. |
| Material of wheel center, Driving wheels, cast steel; trailing wheels, cast iron. | |
| Type of leading wheels | Standard |
| Type of trailing wheels | Improved radial axle |
| Journal, leading axles | 6 x 12 ins. |
| Journal, leading axles, wheel fit | 6 ins. |
| Journal, driving | 9½ x 12 ins. |
| Journal driving axle wheel fit, 9¾ ins.; main, 9½ ins.; front and second | |

| | |
|---|---|
| Journal, trailing | 7 x 12 ins. |
| Diameter trailing wheel fit | 6⅞ ins. |

*Cylinders.*

| | |
|---|---|
| Cylinder, diameter high pressure | 16 ins. |
| Cylinder, diameter low pressure | 28 ins. |
| Cylinder, stroke | 28 ins. |
| Piston rod diameter | 4 ins. |
| Main rod, length center to center | 11 ft. 0 in. |
| Steam ports, length | 29.2 ins.; H. P. and L. P. |
| Steam ports, width | 2 ins. H. P.; 2⅛ ins. L. P. |
| Exhaust ports, least area | 100 sq. ins. |
| Bridge, width | 3¼ ins. H. P., 2¾ ins. L. P. |

*Valves.*

| | |
|---|---|
| Valves, kind of | Improved piston valves |
| Valves, greatest travel | 5¼ ins. |
| Valves, steam lap | H. P. inside 1 in., L. P. outside 1⅛ ins. |
| Valves, exhaust clearance | H. P. outside 0 in., L. P. inside ¼ in. |
| Lead, in full gear | H. P., 1-16 in.; L. P., 1-16 in. |

*Boiler.*

| | |
|---|---|
| Boiler, type of | Radial stayed wagon top. |
| Boiler, working pressure | 200 lbs. |
| Boiler, thickness of material in shell | ¾ in., 25-32 in., 13-16 in., ⅝ in., 9-16 in. |
| Boiler, thickness in tube sheet | ¾ in. |
| Boiler, diameter of barrel front | 70⅛ ins. |
| Boiler, diameter of barrel at throat | 79⅝ ins. |
| Seams, kind of, horizontal | Butt sextuple |
| Seams, kind of, horizontal | Triple |
| Dome, diameter inside | 30 ins. |

*Firebox.*

| | |
|---|---|
| Firebox, type | Wide |
| Firebox, length | 96 ins. |
| Firebox, width | 74 ins. |
| Firebox, depth, front | 74 ins. |
| Firebox, depth, back | 63 ins. |
| Firebox, material | Steel |
| Firebox, thickness of sheets, Crown, ⅜ in., tubes, ⅜ in., side, | ⅜ in., back, ⅜ in. |
| Firebox | Brick arch on water tubes |
| Firebox, mud ring width | Front, 4 ins., sides, 4 ins., back, 4 ins. |
| Firebox, water space at top | Sides, 7 ins., back, 6 ins. |
| Grates, kind of | Rocking |
| Tubes, number of | 352 |
| Tubes, material | Charcoal iron |
| Tubes, outside | 2 ins. |
| Tubes, thickness | 11 B. W. G. |
| Tubes, length over tube sheets | 16 ft. 8⅞ ins. |

*Smoke-box.*

| | |
|---|---|
| Smoke-box, diameter outside | 73 ins. |
| Smoke-box, length from tube sheet | 66½ ins. |

*Other Parts.*

| | |
|---|---|
| Exhaust nozzle, single or double | Single |
| Exhaust nozzle, variable or permanent | Permanent |
| Exhaust nozzle, diameter | 5¾ ins. |
| Exhaust nozzle, distance of tip below center of boiler | 2 ins. |
| Netting, wire or plate | Wire |
| Netting, size of mesh or perforations | 2½ x 2½ ins. |
| Stack, straight or taper | Taper |
| Stack, least diameter taper | 15 ins. |
| Stack, greatest diameter taper | 17 ins. |
| Stack, height above smoke-box | 3 ft. 2½ ins. |

*Tender.*

| | |
|---|---|
| Type | Eight wheel steel frame |
| Tank, type | Water bottom |
| Tank, capacity for water | 6,000 gal. |
| Tank, capacity for coal | 12 tons |
| Tank, material | Steel |
| Tank, thickness of sheets | ¼ in. |
| Type of under frame | Steel channel |
| Type of trucks | B. W. all metal trucks |
| Type of springs | Elliptic |
| Diameter of wheels | 33 ins. |
| Diameter and length of journals | 5 ins. x 9 ins. |
| Distance between centers of journals | 5 ft. 6 ins. |
| Diameter of wheel fit on axle | 5⅜ ins. |
| Length of tender over bumper beams | 22 ft. 1½ in. |
| Length of tank inside | 20 ft. 6 ins. |
| Width of tank inside | 9 ft. 10 ins. |
| Height of tank, not including collar | 5 ft. ½ in. |
| Type of draw gear | Dayton |

*Special Equipment.*

| | |
|---|---|
| Brakes | American and Westinghouse |
| Pump | 9½ ins. |
| Sight feed lubricator | Michigan |
| Safety valves | Ashton |
| Injectors | Hancock and Ohio |
| Springs | French |

Mr. John P. Green, first vice-president of the Pennsylvania Railroad, said at the fifty-fifth annual meeting of the company that the business of the road had outgrown anything that could have been foreseen. It was now necessary to order about 19,000 cars and 260 locomotives. The car required to-day no longer costs from $500 to $600. Fifty-ton steel cars and cars with steel underframes are now required. These cost from $1,000 to $1,100. The style of engine which formerly cost from $8,000 to $9,000 must be replaced by machines which cost from $16,000 to $18,000. The company is thus brought face to face with an expenditure of $25,000,000 for additional equipment. The Pennsylvania Company recently approved of the issue of $50,000,000 3½ per cent. gold bonds, convertible into capital stock at $70. Of this amount $24,000,000 is to be used in buying engines, $[illegible]0,000,000 for real estate and the construction of the New York tunnel and terminal, and $5,000,000 for general corporate purposes. The bonds are to mature in ten years.

## A NEW HIGH PRESSURE BALANCED SLIDE VALVE.

The purpose of this valve, which has just been developed by Mr. J. T. Wilson, president of the American Balance Slide Valve Company, is to furnish a slide valve which will work easily under pressures as great as 250 lbs., and it embodies other important features.

The imperfection in the balancing of the slide valve has been due to the fact that, at different points in its stroke, the pressure on its back varied. In this valve this has been overcome by varying the balanced area to suit the changed condition of the valve at the different points in its travel, thereby balancing the valve under its heaviest pressure, as well as its lightest, and thus maintaining a uniform frictional contact between the valve and its seats, which is just sufficient to form steam-tight joints.

The valve itself, which is very light, is the only moving part, and as the seat is so proportioned that, at the shortest cut-off, the valve travels to the edge of the seat, the valve and the seats should wear straight. The packing forming the balance for the valve is stationary and is, therefore, not subject to wear. This construction may be applied to inside as well as outside admission.

Fig. 1 is a cross sectional view of the valve and balancing arrangement in position in the steam chest; the valve in its central position on the seat. Fig. 2 is a longitudinal section. Fig. 3 is a broken face plan of the steam chest cover, with the cone plate in position on the cover, and half plan of balance plate over the cone plate. Fig. 4 shows the valve at beginning of admission. Fig. 5 shows the valve in the open position, and Fig. 6 shows it at the beginning of exhaust opening.

In Fig. 1 E is the valve. It is open clear through, and is alike on both faces. F and G are slots, or passages, through the valve to give free passage of steam from pocket H, in the balance plate, to the cylinder port, so arranged that communication is always maintained between pocket H and the cylinder port. D is the balance plate. Its face is a duplicate of the valve seat, and is set in direct alignment over the seat. The valve being alike on both faces, the back of the valve operates against the face of the balance plate in unison with the face of the valve against the valve seat. The back of the balance plate is a flat surface, against which the balancing packing forms a steam tight joint. The balance plate rests loosely on the valve, and is free to lift ⅛ in. It is held central by a self-adjusting, double taper, cast iron ring, the lugs on the cover being safety stops. A cone plate C is fastened to the steam chest cover. It contains three cones—the rings fitting these cones form the balance for the valve. The main ring A is the balancing ring. The two small rings B are beveled on the outside to withstand pressure from within, and these rings perform the change in the balanced area. By referring to Fig. 4 it will be noted that steam is being admitted to the cylinder port at one face of the valve and to the pocket port H, in the balance plate, by the other face of the valve. From the pocket H it passes through the passage K into the interior of one of the rings B, and counteracts the upward pressure of the steam in the port. At the same time it passes through passage F and the valve into the cylinder port, giving double admission to the cylinder. The interior of the small rings B are in communication with the cylinder ports at all times, there being no position of the valve that can cut this communi

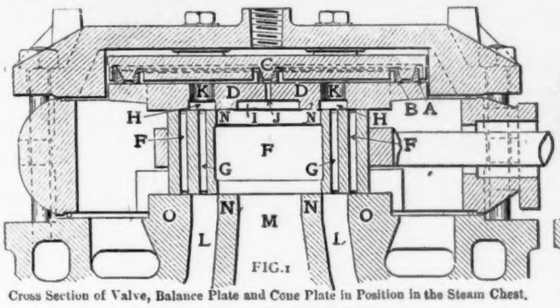


FIG.1

Cross Section of Valve, Balance Plate and Cone Plate in Position in the Steam Chest.

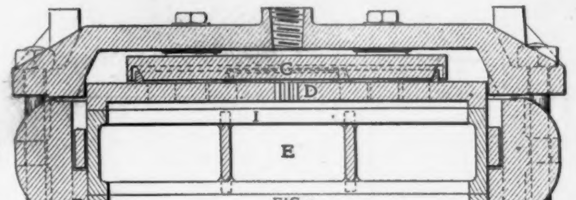
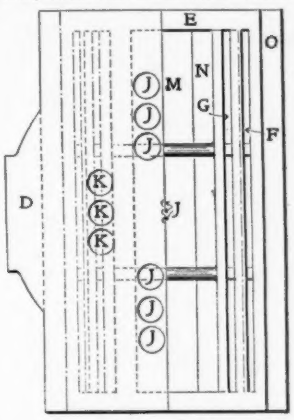
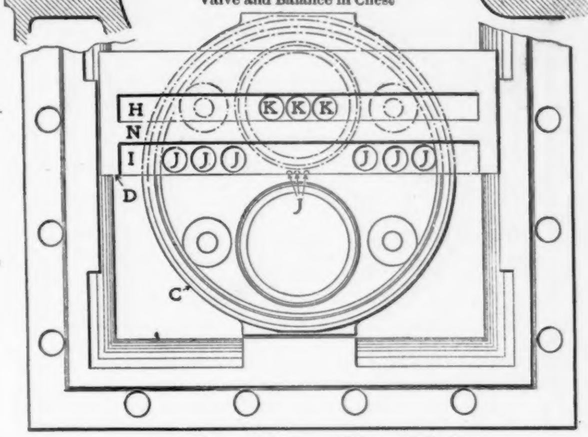


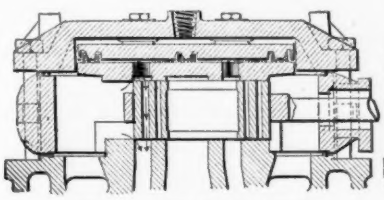
FIG.2
Longitudinal Section through
Valve and Balance in Chest



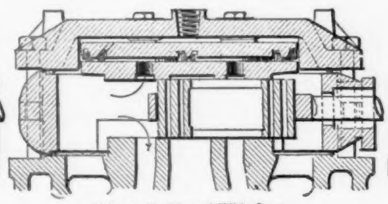
Plan of Valve on Valve Seat and
Half Plan of Balnce Plate



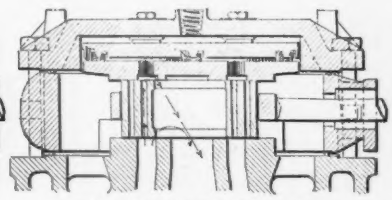
Plan of Steam Chest Cover (Face up) With Cone
Plate and Balance Plate in Position.



Valve in Position of Opening, Showing
Double Admission of Steam to Cylinder.
FIG. 4



Valve in Position of Wide Open.
FIG. 5



Valve in Position of Exhaust Opening, Showing
Double Exhaust of Steam from Cylinder.
FIG. 6

A. E.

**Wilson's New Balanced Slide Valve for High Pressures.**

cation off. Therefore, whatever pressure is in the cylinder port is on both faces of that portion of the valve over the port, and is on the back of the balance plate in the interior of the ring B, which in area equals the area of the steam port, thereby neutralizing all pressures in the ports, and the valve is balanced regardless of the pressure in the steam port. In Fig. 5 the valve is shown over the seat on the right. This portion of the valve has pressure on both sides of it, and is, therefore, balanced. In order to correctly appreciate the perfection of balance in this valve we will again refer to Fig. 4, where we find an amount of the valve face equal to the area of the steam port, suddenly balanced by the admission of steam to the port and to the pocket port H. This virtually reduces the size of the valve from its size as shown in Fig. 1, when the whole valve face is on the seat. This reduction in the size of the valve (properly the frictional contact of the valve) is cared for by the reduction of balanced area in equal proportion, and it will be noticed now that the edge of the valve at the right is at the edge of the seat, and that further movement of the valve does not change the area of contact unless the bridge is over traveled more than one-third, which, in this valve, with double openings, is not necessary. In Fig. 6 we find the valve exhausting, and the steam passing out through the passage F at the same time as at the face of the valve, and thus securing the very valuable feature of double exhaust opening.

Valves of the same design are in heavy fast passenger service on the Lehigh Valley Railroad, giving excellent satisfaction. It is now being applied by other large roads, and new locomotives in several modified forms.

It is claimed that this valve is the nearest approach to a perfect balance that has been obtained, while retaining an automatic adjustment for wear, which feature can be considered indispensable for economical and efficient valve service. Other very valuable features are embodied in this design, and the whole combination seems simple and clear, and in service should show a marked improvement in efficiency and durability. Further information may be obtained from the American Balance Valve Company, Jersey Shore, Pa.

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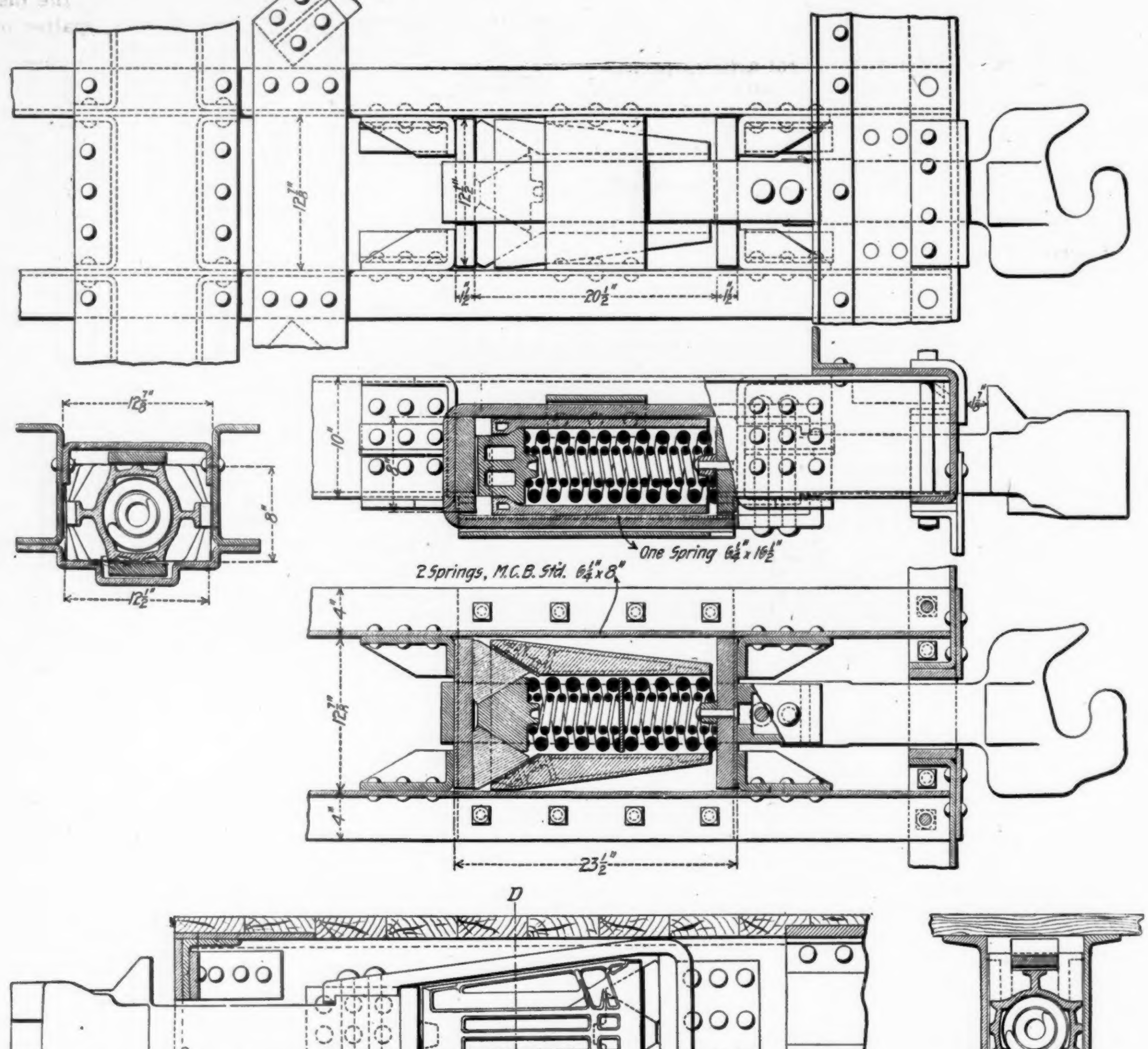
Derailments at interlocking plants were discussed at a recent meeting of the Railway Signaling Club in Chicago. The chief cause of such accidents is the usual absence of electric locking, which insures against mistakes of operators, whereby signals may be changed from "all clear" to "stop" indications, and the derails opened in the face of approaching trains. Electric locking prevents this, but the chief objection to it is the difficulty of maintaining electric locks at outlying crossings. A time lock on the home signal levers was suggested as a remedy by Mr. Charles Dunham, signal engineer of the Illinois Central. This device would prevent the operator from changing the signal until a certain time had elapsed after the signal is cleared, and as the same signal controls the opening of the derail, the lock would be a safeguard. The advantage of a time lock is in maintainance, and in this respect the device seems to be worthy of consideration. It can not be as great a protection, however, as a properly maintained electric lock.




**The New Sessions Standard Friction Draft Gear for Narrow Sill Spacing.**

## THE NEW SESSIONS STANDARD FRICTION DRAFT GEAR.

As Applied to Vanderbilt Coal Cars.

This draft gear was illustrated on page 390 of our December number of last year. It is now being applied to the Vanderbilt coal cars for the West Virginia Central & Pittsburgh Railway illustrated in this issue), in an improved form, which is illustrated by these engravings. Without changing in any way the essentials of the device it has been redesigned so that it may be used between sills with a minimum distance apart of 8¼ ins.

This is accomplished by tapering the barrel, and when placed, as shown in the lower views, it will lie between sills with that spacing. When turned, as in the upper engraving, it requires 12⅞ ins., which is usual in steel car construction.

For special cases, therefore, by turning the gear on its edge it will go between sills which are arranged for the M. C. B. gear. When placed in this way the followers are short, and with 1½ in. followers the gear measures 23½ ins. over the followers. This improvement employs all of the features of the original construction, and the flexibility of arrangement is accomplished by changing the shape of the barrel and making the yoke conform to it. The flanges at the small end of the barrel are removed, and the metal is so disposed as to increase the strength. The only additional parts are chafing plates, placed between the barrel and the yoke. A large number of these gears have been sold, but the application to these cars is the first to be made on cars in actual service construction. Further information may be obtained from the Standard Coupler Company, 160 Broadway, New York.

## THE WATER QUESTION.

### I.

[Editor's Note.—This is the first of several articles prepared specially for the American Engineer by a well-known chemist and engineer who has made a thorough study of this subject.]

The constantly increasing severity of the duties imposed upon the locomotive renders it imperative that conditions for high performance be as perfect as possible. Water of the proper quality for steam raising purposes is a necessary adjunct to good performance.

The water question with railroads is subject to its own peculiar conditions, for a railroad must depend upon the country through which its lines run to obtain feed water. It cannot, as other steam users frequently do, use the fact of the presence of pure feed water as a deciding factor in locating, but must locate watering stations at fairly regular intervals, and where several sources of supply are at hand take that which is best, or, as it might usually be stated, that which is least bad. Owing then to the peculiar conditions of water service to which railroads are subject, we may at once dismiss the question of locating upon a good source of water supply, and must turn our attention to methods having in view the amelioration of objectionable conditions.

Errors of judgment are frequently made in considering the action of various waters in locomotive boilers, due to the fact that most locomotives use water from a number of water stations and a result obtained may not be from the last tank of water drawn, but from a previous one. For instance, suppose a tank of water is drawn at "A," and before this is entirely taken into the boiler a supply is taken from "B." After leaving "B" priming or foaming takes place, but it does not follow that the trouble is caused by water from "B"; it is in fact more than likely that the trouble is due to the concentration of soluble salts in the water from "A," although many engineers would blame the water from "B."

Incrustation or scale, which increases coal consumption and lowers the steaming capacity, is an accumulative evil, and in locomotive boilers is, as a rule, the result of the action of a number of waters.

Corrosion is due to the solvent action of the water or some substance held in solution thereby.

The first question which naturally arises is why does a certain water form incrustation or cause corrosion or foaming. Naturally the best method of finding this out is by careful chemical analysis, and opinion upon this analysis by a competent and, above all, a practical chemist. It is not sufficient that the superintendent of motive power be furnished simply with a string of figures attached to a list of long chemical names, but he should be informed also of the action of the various compounds and substances found in the water.

Chemical names and symbols are frequently confusing, and following are some of the common names of incrusting solids most frequently found and reported in an analysis of boiler feed water:

| Chemical Names: | Common Names: |
|---|---|
| Carbonate of lime or calcium | Chalk, marble. |
| Carbonate of magnesia | Magnesia (boiler lagging). |
| Sulphate of lime | Plaster of Paris. |
| Sulphate of magnesia | Epsom salts. |
| Silica | Sand |

Having then found the substances causing the trouble in the water proper steps must be taken to prevent their action, such as the prevention of the formation of scale or corrosion. Much confusion has resulted when chemical analyses are under consideration, due principally to the different methods adopted by chemists in calculating and reporting analyses. The question of the proper way to combine the various bases and acids found in water is still an open one. Some chemists report bases and acids separately, and simply state so many grains of lime and magnesia, so many grains of sulphuric acid, and so many of chlorine, thus shirking all responsibility and leaving to the one who receives the analysis the task of making the combination to suit himself. The matter of calculating a water analysis is of such importance that it would seem best that some concerted action should be taken by chemists, having in view the adoption of uniform practical methods.

Railroad chemists usually report analyses in grains per gallon. This method is perhaps intelligible to the chemist, but how many men not versed in chemistry know that one grain per gallon is one part in 58,418. "Pounds per thousand gallons" is grasped at once. Grains per gallon are converted into pounds per thousand gallons by dividing by seven. Thus a water containing fourteen grains per gallon of incrusting solids carries into the boiler two pounds of such solids in each thousand gallons of water used. The next subject to be treated is incrustation.

(To be continued.)

## BRAKE SHOE TESTS.

Whether a brake shoe, which wears well, is an efficient train retarder, is the question with which Mr. W. H. Stocks, master mechanic of the Chicago, Rock Island & Pacific Railway, dealt in a paper read recently before the Western Railway Club. He tested two kinds of shoes, equipping one side of an engine with one type and the other side with the other. Two engines were so equipped. One shoe, designated "A," was of cast iron with two curved inserts of very hard white iron on the outer tread-bearing portion, and three similar inserts on the portion covering the wheel flange, the center portion over the limits of rail wear being cut away. The shoe designated "B" was cast iron, with four crucible cast-steel inserts arranged along the outer tread-bearing portion, and three disposed along the flange groove. The shoe was recessed over the limits of rail wear, and was heavily chilled on its beveled ends. The "B" shoe showed such superior wearing qualities that its frictional efficiency as a train retarding agent was seriously doubted. This led to further tests with dynamometer car attached. Two stops were made with each set of driving shoes at 40, and two at 65 miles per hour. The conclusions drawn were that from a frictional standpoint there was practically no difference between them. As regards durability, the "B" shoe had three and a half times the life of the "A" shoe. It was 12½ per cent. heavier, which slightly reduces its advantage, but at the same price per pound it must be more economical of the two. No accurate data exist as regards the tire-dressing qualities of the shoes, but the opinion of those concerned appears to be that the "B" shoe is in this also superior.

B. M. Jones & Co., representatives of Taylor Brothers & Co., of Leeds, England; Samuel Osborn & Co., of Sheffield, and other firms, have removed their Boston office to 159 Devonshire street.

Mr. John H. Allen has been appointed manager of the Chicago office of the Standard Railway Equipment Company, with headquarters in suite 707, Great Northern Building. He succeeds Mr. H. V. Kuhlman, who has resigned to engage in other business. Mr. Allen will direct the company's affairs in Chicago in the sale of Monarch Pneumatic tools and Murphy car roofs.

The manufacture of pinions for street railway motors by the pressing process has been accomplished in Brooklyn. The object is to secure toughness and durability superior to the usual cut gears. Dies are used, and pinions are pressed out of cylindrical billets by a 500-ton press. It is stated that by this process a high carbon, hard steel may be used. Thus far the process has been applied only to pinions.

## PERSONALS.

Mr. H. H. Vaughan has been appointed Assistant Superintendent of Motive Power of the Lake Shore & Michigan Southern Railway. He succeeds Mr. H. F. Ball, formerly Mechanical Engineer, who has been promoted to the position of Superintendent of Motive Power. Mr. Vaughan thus occupies a new position on this road, and while he will act as Mechanical Engineer, the duties of the office fully justify the broader title. Mr. Vaughan was educated in a technical college in London, being an Englishman by birth. He entered railroad service in this country as a machinist on the Great Northern Railway in 1891, and soon became mechanical engineer under Mr. Pattee, at St. Paul. While in this position he designed and patented among other things, the engineer's brake valve, which was adopted by the New York Air Brake Company. In 1897 he was appointed Mechanical Engineer of the Philadelphia & Reading, and about two years later took charge of the manufacturing interests of the Q. & C. Company in Chicago, which was afterward absorbed by the Railroad Supply Company. In this capacity he has made a special study of pneumatic tools, and also has designed a number of machine tools and automatic machines. In all this work he has found time to write for the American Engineer, and his masterly analysis of the investigations on the subject of locomotive stacks and nozzles, published by us in connection with the American Engineer Tests on Locomotive Draft Appliances, is undoubtedly his most important work in this direction. He combines in an unusual degree, engineering knowledge, mechanical and investigating ability with a good business experience, and is one of the kind of men greatly needed by railroads. The Lake Shore is to be congratulated upon this important addition to its mechanical staff, and Mr. Vaughan is fortunate in having an opportunity to join that staff.

Mr. C. H. Hogan, master mechanic New York Central & Hudson River, of East Buffalo, N. Y., has been appointed master mechanic of the River division of the West Shore, with headquarters at New Durham, N. J., to succeed Mr. E. A. Walton, promoted, and Mr. J. O. Bradeen has been appointed master mechanic at East Buffalo, to succeed Mr. Hogan. Mr. W. J. McQueen has been appointed assistant master mechanic of the Hudson, Harlem and Putnam divisions of the New York Central, with headquarters at Mott Haven, N. Y.

Mr. George Gregg has been appointed master mechanic of the Chicago & Alton at Bloomington, Ill., to succeed Mr. V. B. Lang, who has resigned to become master mechanic of the Alabama Great Southern, with headquarters at Birmingham, Ala., succeeding Mr. W. N. Cox, resigned.

Mr. H. G. Hudson, master mechanic of the "Big Four" at Mount Carmel, has been transferred to the same position on the Michigan division, with headquarters at Wabash, Ind. He succeeds Mr. G. Wirt, who is transferred to Delaware, O., to succeed Mr. M. Rickert, resigned.

Mr. W. H. White has been appointed acting purchasing agent of the New York, New Haven & Hartford, with headquarters at New Haven. For twelve years he has been chief clerk of the department, and succeeds Mr. H. A. Bishop, resigned.

Mr. J. S. Goddard has been appointed chief draftsman of the Chicago, Burlington & Quincy to succeed Mr. C. B. Young, who was recently promoted to the position of mechanical engineer. Mr. Goddard is a graduate of the University of Michigan.

Mr. Tracy Lyon has been promoted from the position of general superintendent to that of assistant general manager of the Chicago Great Western. Mr. G. A. Goodell has been appointed general superintendent to succeed him.

Mr. F. A. Torrey has been appointed master mechanic of the Chicago, Burlington & Quincy at Creston, Ia., to succeed Mr. E. Jones, who has resigned.

Mr. David Patterson has been appointed division master mechanic of the Gulf, Colorado & Santa Fe at Raton, N. M., to succeed Mr. C. M. Taylor, promoted.

Mr. T. B. Purves, superintendent motive power of the Boston & Albany, after April 1 will transfer his headquarters from Springfield to Boston.

Mr. I. N. Funk has been appointed acting master mechanic of the "Burlington" at Ottumwa, Ia., to succeed Mr. F. A. Torrey, promoted.

### THE 20,000TH BALDWIN LOCOMOTIVE.

The Baldwin Locomotive Works celebrated the building of their 20,000th locomotive, February 27, by a banquet at the Union League Club, Philadelphia. It was a notable occasion. The guests included many men whose achievements have made them famous. At the table of honor were the following: E. H. Harriman, William P. Henszey, George F. Baer, Alexander J. Cassatt, John H. Converse, Wayne MacVeagh, Stuyvesant Fish, Geo. Westinghouse, Jr., J. Harris Sanders, Joseph G. Darlington, Clement A. Griscom, Thomas Dolan, James M. Beck, Charles Smith, Edward Longstreth, William Sellers, John G. Johnson, Bishop Cyrus D. Foss, Col. Alex. K. McClure, Robert Adams, Jr., Capt. John P. Green, P. A. B. Widener, William L. Elkins, Frank A. Vanderlip, Edward Atkinson, Samuel H. Ashbridge, Charles A. Dickey, D. D., Samuel R. Callaway, George S. Webster, Joseph L. Caven, Robert C. Lippincott; and in all, the guests numbered 263. The banquet hall was beautifully decorated with flowers, and the arrangements were perfect. The speakers were:

George F. Baer, "Industries of Pennsylvania."
John P. Green, "The Pennsylvania Railroad."
Stuyvesant Fish, "Aristocracy and Democracy."
James M. Beck, "Unity of the Republic."
J. Harris Sanders, "American Development from an English Standpoint."

Throughout, the addresses were admirable, constituting a tribute to railroads, and particularly to the locomotive, for its part in the development of the country. No one attending this pleasant assemblage could fail to better appreciate the locomotive, or fail to be deeply impressed by the part taken by the Baldwin Locomotive Works in its development.

Mr. J. F. Deems, who has just retired from the position of superintendent of motive power on the Chicago, Burlington & Quincy Railroad, to become general superintendent of the American Locomotive Company's plant at Schenectady, N. Y., was recently tendered in Aurora a flattering testimonial from his former subordinates. The gift to Mr. Deems was a gold watch, Elgin make, of railroad pattern, but the significance of the presentation lay in the expression of genuine love and esteem which his parting with those who had worked under him evoked. The former superintendent of motive power was most deservedly popular, because of his ability to know his men, and with all the departmental routine and official intercourse, which is inseparable to the discharge of his duties, he had reached below the surface and had found the human side of those with whom he worked. As showing his personal sympathy, he said in his reply after the presentation: "If I have in any way made easier the rough pathways of life, if I have gained your friendship and confidence and respect, I feel that I have accomplished something in life, and am satisfied."

## FIRE DOORS.

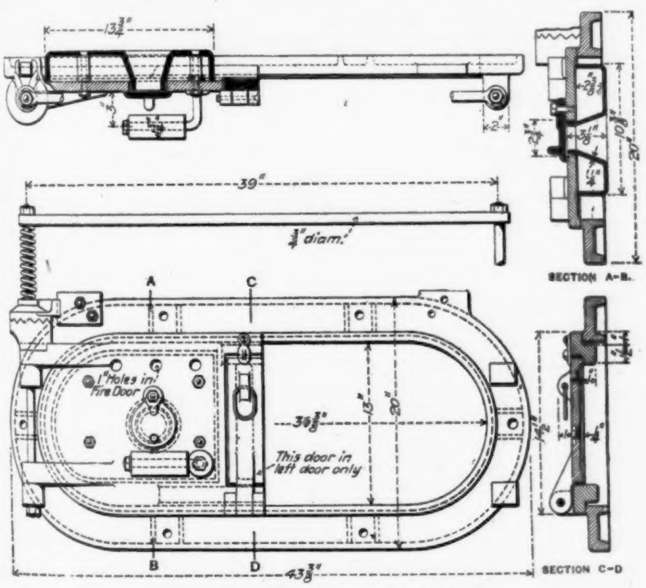
By G. S. Edmonds.

In one of the recent editions of a technical publication attention is pointedly called to the amount of experimentation and thought given the subject of steam distribution, as governed by cylinders and valve motion, of the locomotive, to the almost total neglect of its generation in the boiler.

The February number of the American Engineer makes the statement, "there must be something about the wide grate that is not fully understood."

This, as a basis for thought, has given rise to this communication, which, while non-affirmative, may be suggestive, and awaken discussion. If it should lead to the alleviation, or, better, eradication of some of the difficulties experienced, with consequent increase in efficiency, its purpose is attained.

A factor of importance with the boiler, but one too often receiving little consideration, is the fire door. If an examination be made of the recent designs governing wide firebox practice, it will be noted in the majority of cases that there are two openings, spaced some 25 to 45 ins. centers, dependent on the width of the grates. It is reasoned as advantageous compared with the single door, because more ready access is had to all parts of the grate surface for both cleaning and firing. With two doors there is less cooling action over the fire surface as a whole, with its consequent advantage as to steam when firing. One side may be taken care of at a time, hence liability of steam going back, when partially cleaning on road, is materially decreased. There are also other claims for two doors.




Locomotive Fire Door —D. & H. Co.

Realizing the direct bearing of that variable quantity, "personal element," on the efficiency, does it, with two doors to open and fire, located as above, decrease the manual energy expended, as compared with the single divided door, when the major portion of the fire can be readily controlled with either the right or left half?

As to cleaning, when partially so doing on the road, assume that the right section of the fire first receives attention. This door is opened, the fire shaken, dead spots repaired and recoaled. Meanwhile cold air has been entering. Follow its course, and it will be found that the action on the tube sheet is felt on an area the center of which lies relatively near the outer row of flues. The remaining portion of the sheet is kept at the same temperature as before, the left-hand division of the fire being as yet untouched. Does not this alternate cooling, unevenly distributed over the tubes by the double opening, have a greater detrimental effect than where, as is the case with the single door, its influence more nearly affects the sheet as a whole, radiating from its center? Furthermore, do not such conditions exist in a minor degree during the entire period of firing?

Experience teaches, more forcibly with hard coal, that during this period of road cleaning the steam drops back, possibly to a greater extent with the single door, inasmuch as work is done over a larger portion of the grate. To obviate this why not reduce the air inlet during this period to a minimum. This has been done by means of the door shown in this sketch, and is being experimentally tried on the road with which the writer is connected.

For the removal of dead spots and air holes (which, in passing, it may be noted, are often caused by rigid adherence to the accepted practice of 45, or thereabouts, per cent. of air opening in grates, rather than in accordance with the grade of fuel), as well as cleaning of the fire, the right-hand half of the door is opened, the rake inserted in the opening made by dropping down the small center door. The area for admission of air is in this manner reduced to some 10 by 2¾ ins., the importance of which is best known by the fireman, when the fire begins to die in spots on a grade, with a heavy freight, or fast passenger, a drop of steam meaning either stalling or loss of time.

Considering the end of the run, if the coal is poor (and few roads receive near relations of the cannel product) a slaggy accumulation is formed. With a single opening approximating 13 by 36 ins., is not the opportunity for readily removing this debris much better than with the two doors of 16 or 17 ins. diameter? Further, should not the deleterious effect on flues already noted be decreased, for the reason previously mentioned, viz., more equal distribution of cold air on the sheet, and less time during which the door is open for its admission?

## PENSION SYSTEM, METROPOLITAN RAILWAY, NEW YORK.

Mr. H. H. Vreeland, president of the Metropolitan Street Railway of New York, has announced the plan of a pension system for that road, which will affect all employees whose annual wages do not exceed $1,200. The company has 15,000 employees.

This pension system provides for voluntary and involuntary retirement of all employees so included between the ages of sixty-five and seventy after twenty-five years' service in the Metropolitan Street Railway Company or any of its constituent companies. Employees benefited by the system will be of two classes.

First—All employees who have attained the age of seventy years, who have been continuously in such service for twenty-five years or more preceding such date of maturity, and

Second—All employees from sixty-five to sixty-nine years of age who have been twenty-five years or more in such service who, in the opinion of the trustees of the pension, have become physically disqualified.

All employees of seventy years will be considered to have attained a maximum age allowed for active service, and will be retired by age limit, while those whose ages range from sixty-five to sixty-nine may, upon examination, be retired under pension if found incapable. The pension allowance to such retired employees shall be upon the following basis:

(a) If service has been continuous for thirty-five years or more, 40 per cent. of the average annual wages for the ten previous years.

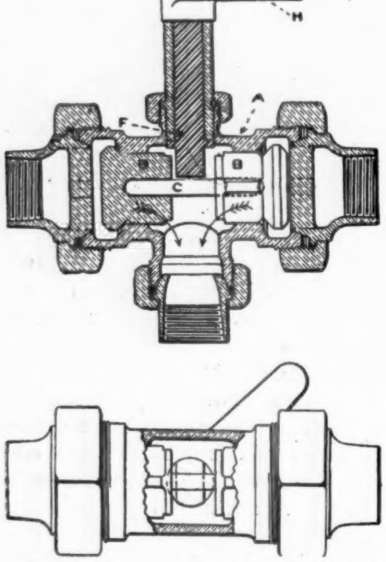
(b) If service has been continuous for thirty years, 30 per cent. of the average annual wages for the ten previous years.

(c) If service has been continuous for twenty-five years, 25 per cent. of the average annual wages for the ten previous years.

The fund from which payments will be made will be appropriated each year by the company, and employees will not be required to contribute to it.

## LUNKENHEIMER AUTOMATIC LOCOMOTIVE CYLINDER COCK.

The new Lunkenheimer automatic cylinder cock for locomotives consists of a valve casing, A, which contains two wing valves, B B, which are connected together by a loose pin, C. The valves, B B, open and close alternately as steam is admitted or exhausted through the opposite ends of the cylinders, to which the inlets of the cock are connected. In this manner the device is in constant operation, relieving the cylinder of condensation. The stem, F, is operated from the cab by means of a lever. When the stem, F, is placed in its central position, both valves, B B, are held off their seats at the same time, and the water of condensation will be drawn off from both ends of the cylinder. The Lunkenheimer Company, of Cincinnati, Ohio, manufacture this device, and will be pleased to give full information concerning it to those interested.



Lunkenheimer Automatic Locomotive Cylinder Cock.

## LOCOMOTIVE CYLINDER CLEARANCE.

Referring to indicator cards published October, 1900, in the American Engineer and Railroad Journal, Mr. Ira C. Hubbell, in a paper before the Railway Club of Pittsburg, stated that the compression there shown was carried considerably above the initial pressure and that excessive back pressure was present, indicating that clearance had been reduced below the point justified by the valve movement, and the locomotive must, therefore, have been operated at a loss. The cylinder clearance in question was 5 per cent. He emphasized the importance of the effect of cylinder clearance upon the economy of the steam engine, locomotive, stationary or marine. In one card, taken at a speed of 75 miles per hour, with drivers turning 319 revolutions per minute at 5-in. cut-off, the lead is 9/32 in., and mean effective pressure, 46.34 lbs. He says the pre-admission was probably not less than 3 ins., and that fact calls for attention to avoid a very serious loss.

Since the first of this year the Atchison, Topeka & Santa Fe has ordered Pintsch lighting equipment for eighty-three cars. Previous to the placing of that order they had seventy-four of their passenger cars equipped with it, so that the total number now gas lighted on the road aggregates 157. The Pintsch Compressing Company are about to erect a Pintsch gas works at Point Richmond, where gas will be manufactured for the road, and a Pintsch supply station will also be established at Barstow, Cal., while a Pintsch gas works has just been completed at El Paso, Tex., where the Atchison cars on that division will be supplied.

The Bullock Electric Company, of Cincinnati, O., has issued a neat pocket calendar for 1902, with twelve illuminated pages, each containing the calendar for the month and the vignette of some master worker in the domain of physics. On the back of every page appears a brief account of the life and work of the twelve distinguished men selected. They are Benjamin Franklin, Michael Faraday, Sir Charles Wheatstone, Hermann Von Helmholtz, Lord Kelvin, Jas. Clerk Maxwell, Henry A. Rowland, Werner von Siemens, Elihu Thomson, John Hopkinson, Gisbert Kapp, and C. E. L. Brown. It is a happy grouping of representative English, American and German men of science.

## EQUIPMENT AND MANUFACTURING NOTES.

Mr. C. H. Hogan, Master Mechanic of the Western Division of the New York Central, who was recently transferred to a similar position on the Mohawk Division, was recently presented with a silver set and handsome diamond as a token of the esteem of his recent subordinates. The gift represented $1,500, which was subscribed for the purpose. The gifts were made by the Webb C. Ball Company, of Cleveland.

The O. M. Edwards Company, of Syracuse, N. Y., have established an office and show room in Chicago, located at 501 Fisher Building, which will be in the charge of Mr. Edward E. Silk, as western manager. The increasing business of the company has made it necessary to open a western office, where a complete line of samples and models may be seen. Mr. Silk is well known to our readers as formerly associate editor of this journal.

The Clayton Air Compressor Works, Brooklyn, N. Y., are anxious to correct a statement which has gained currency in some quarters, to the effect that they had sold out and gone out of business. Nothing is farther from the truth. This combine has made no changes that will in any way alter their business relations with their various customers. With new capital they are enlarging their works, and expect to serve their patrons better than in the past, and to give them an advantage in prices on improved machinery and new designs. The New York office is at 120 Liberty street.

The Franklin Manufacturing Company, of which Mr. Chas. S. Miller is president, has acquired the exclusive right to sell the boiler lagging made by the Keasby & Mattison Company, of Ambler, Pa. The Franklin Company will handle this lagging in the United States, Canada, Mexico, South and Central America. It is composed of 85 per cent. pure carbonate of magnesia. The Franklin Company has made a careful, practical and scientific examination of the whole field and has determined that this sectional lagging is of the very highest quality. They have therefore great confidence in putting it upon the market.

The Sargent Company, of Chicago, which has heretofore been operating an open-hearth steel plant for the manufacture of draw-bars, knuckles, coupler parts for repair, and has been working a plant at Chicago Heights, Ill., for the manufacture of Tropenas steel castings and steel and iron brake shoes, has transferred the plant at Chicago Heights, with the business done there, to the American Brake Shoe and Foundry Company, which company will hereafter conduct the business of this department from its office at Chicago Heights. The Sargent Company will continue the operation of the open-hearth steel plant at Fifty-ninth street, Chicago, where its general offices will be located. The Sargent Company is having plans drawn for an extension to its plant which will approximately treble its capacity.